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A CASE STUDY OF THE ADVANCED AMPHIBIOUS ASSAULT VEHICLE (AAAV) PROGRAM FROM A PROGRAM MANAGEMENT PERSPECTIVE

by

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This research effort focused on the program management issues of the U.S. Marine Corps' Advanced Amphibious Assault Vehicle (AAAV) Program. The research answered the primary question of what were the critical program management decisions during the early phases of the program and how would an analysis of these decisions affect the future of the AAAV program. Interviews were conducted with key personnel from the AAAV office and General Dynamics Land Systems. Additionally, program documents and other relevant literature were reviewed. The key findings of the research effort concluded that reducing technical risk early in program is critical; Program Managers (PMs) must influence system design as early as possible; physical collocation of Government and contractor personnel facilitates the implementation of

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A CASE STUDY OF THE ADVANCED AMPHIBIOUS ASSAULT VEHICLE (AAAV) PROGRAM FROM A PROGRAM MANAGEMENT PERSPECTIVE

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ABSTRACT

This research effort focused on the program management issues of the U.S. Marine Corps' Advanced Amphibious Assault Vehicle (AAAV) Program. The research answered the primary question of what were the critical program management decisions during the early phases of the program and how would an analysis of these decisions affect the future of the AAAV program. Interviews were conducted with key personnel from the AAAV office and General Dynamics Land Systems. Additionally, program documents and other relevant literature were reviewed. The key findings of the research effort concluded that reducing technical risk early in program is critical; Program Managers (PMs) must influence system design as early as possible; physical collocation of Government and contractor personnel facilitates the implementation of Integrated Product and Process Development (IPPD) and Integrated Product Teams (IPTs); the use of IPPD and IPTs has helped the AAAV program but personnel need to be trained before implementation; adopting an evolutionary acquisition strategy will help prevent component obsolescence prior to fielding; and PMs should use special contracting provisions to incentivize contractors to reduce total ownership costs.

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I. INTRODUCTION

A. BACKGROUND

The Department of Defense (DoD) has been under close scrutiny by Congress over the past two decades because of its inability to field major defense acquisitions on time and at cost. [Ref. 1:p. 21] Previous attempts by DoD to reform its acqusition process have met with only limited success. The latest attempt, initiated in 1994, attacks the procurement process by examining every step in the process and determining if there is a better way to do business. Some central themes to the current acquisition reform initiative include adopting commercial business practices, use of Integrated Product and Process Development (IPPD) and Integrated Product Teams (IPTs), Cost As an Independent Variable (CAIV), and use of Performance Specifications vice detailed Military Design Specifications. [Ref. 2]

In 1990, Congress passed the Defense Acquisition Workforce Improvement Act (DAWIA) which mandated that DoD establish a professional acquisition workforce. Congress intended for this professional workforce to improve DoD's poor acquisition record by providing a core of experienced personnel to manage these complex programs. [Ref. 3]

Program Managers (PMs) for major defense acquisition programs face a daunting challenge to keep their program within stated cost, schedule, and performance parameters. They have many tools available to assist them in

managing their programs but there is no substitute for experience. PMs must draw upon the experiences of others to avoid repeating another's mistakes. Lessons learned from a successful program should be published so that everyone within the acquistion community can see which initiatives were successful and which ones were not. This case history examines lessons learned from the Advanced Amphibious Assault Vehicle (AAAV) program that can be applied to other major defense acquisition programs.

In the early 1970s, the Marine Corps realized that it would eventually need to replace the Assault Amphibian Vehicle (AAV) in service at that time. [Ref. 4] The Advanced Amphibious Assault (AAA) concept was developed to meet the evolving doctrine of quickly inserting Marines ashore from ships over-the-horizon. After various alternatives were explored, it was determined that a vehicle would best meet the needs of the AAA concept. [Ref. 5:p. 2]

The Marine Corps attempted three times, beginning in the early 1970s to the mid 1980s, to field a replacement vehicle for the AAV. [Ref. 4] The AAA program was finally approved in July 1988 and a Program Management Office (PMO) that focused on the AAAV was established in June 1990. [Ref. 6:p. 2] Two contractors, General Dynamics Land Systems (GDLS) and United Defense Limited Partnership (UDLP) (formerly known as the Food Machinery Corporation (FMC)), were used during the Concept Exploration (CE) phase to develop the best vehicle concept to meet the needs of the Marine Corps. [Ref. 5:p. 2] Following the Milestone I decision in March 1995, GDLS was awarded a Cost-

Plus-Award-Fee (CPAF) contract in June 1996 to develop the AAAV prototype during the Program Definition and Risk Reduction (PDRR) phase. [Ref. 7] During this phase, several unique requirements were placed on the contractor. First, the contractor was given a specific geographic region (Northern Virginia) in which to locate its facility. Second, the PMO was required to be collocated with the contractor. Finally, the contractor was required to use an Integrated Product and Process Development (IPPD) program with Integrated Product Teams (IPTs) consisting of both contractor and Government employees. [Ref. 7] These requirements significantly changed the environment in which both the PMO and contractor worked. It also had a significant impact on the way day-to-day business was conducted. [Ref. 7]

The collocation, IPTs and CPAF contract have provided many advantages during the PDRR phase of the AAAV program. [Ref. 7] There have also been many challenges to overcome since these management techniques had not been used in this fashion in a Major Defense Acquisition Program before.

Despite the challenges faced during this era of acquistion reform, the AAAV PMO has flourished. It has been recognized as a model PMO and can certainly offer many valuable lessons that can be used by other PMOs. [Ref. 8]

Appendix A contains a case study on the AAA program written by the researcher and Major Ronald R. Dalton, USMC. Major Dalton was a student in the Acquisition and Contracting Curriculum at the Naval Postgraduate School and graduated in December 1998. The case study was not completed in time to

be included in Major Dalton's thesis titled "A Case Study of the Advanced Amphibious Assault Vehicle (AAAV) Program from a Contracting Perspective."

B. RESEARCH OBJECTIVE

The objective of this research is to examine the program management decisions made during the early phases of the AAAV program. The goal is to determine what impact these decisions had on the AAAV program at the time, the future implications of these decisions, and if these decisions can benefit other major defense acquisition programs. The research included conducting a thorough review of all available program documents, conducting interviews with program management personnel, conducting an interview with a representative from GDLS, and conducting an analysis of these critical decisions.

C. RESEARCH QUESTIONS

The primary research question is: What have been the critical program management decisions and events regarding the Advanced Amphibious Assault Vehicle (AAAV) program, how have these affected the nature and scope of the AAAV program as it exists today, and how will an analysis of these critical decisions and events affect the development, production, and deployment of the AAAV? The subsidiary research questions are as follows:

1. What was the original Advanced Amphibious Assault (AAA) concept and how did it lead to the establishment of the AAAV program?

2. What was the Marine Corps' initial acquisition strategy for the AAAV program and how has it evolved?

3. What was the organizational structure used to execute the acquisition strategy of the AAAV program?

4. What have been the critical acquisition decisions of the Program Management Office (PMO) and how have they impacted the AAAV program?

5. What impacts have Integrated Product and Process Development (IPPD) and Integrated Product Teams (IPTs) had on the PMO and the AAAV acquisition effort?

6. How might an analysis of program management decisions made in the early phases of the AAAV program be used in the successful execution of other defense acquisition programs?

D. SCOPE

The scope of this case study is limited to determining what program management lessons can be learned from the AAAV PMO. The study will analyze the program management decisions made within the PMO and determine whether or not they can be applied to other major defense acquisition programs.

E. METHODOLOGY

The methodology used in this research consists of the following: (1) a literature search of books and magazine articles relating to amphibious operations and equipment, (2) a review of available AAAV program related material, and (3) personal and telephonic interviews with personnel assigned to the PMO and GDLS.

F. ORGANIZATION OF THE STUDY

Chapter I. Introduction Identifies the focus and purpose of the thesis and states the primary and subsidiary research questions.

Chapter II. Background of the AAAV Program Provides the reader with an historical perspective of amphibious assault doctrine and vehicles from their introduction through the current AAAV program.

Chapter III. Acquisition Process Discusses the program management acquisition strategies, decisions, and key events of the AAAV program.

Chapter IV. AAAV Critical Acquisition Decisions Analyzes the critical program management decisions that have been made in the AAAV program.

Chapter V. Conclusions and Recommendations Summarizes the findings of the research, answers the research questions, and provides recommendations from this study.

G. BENEFITS OF THE STUDY

This study will provide program managers with a comprehensive review of Lessons Learned from the AAAV PMO. These Lessons Learned can then be used in other major defense acquisition programs to build upon the successes of this PMO and avoid their pitfalls.

II. BACKGROUND

A. INTRODUCTION

This chapter will cover the history of amphibious assault vehicles in the Marine Corps, the doctrinal changes that led to the establishment of the Advanced Amphibious Assault Vehicle (AAAV) program, and the establishment of the Direct Reporting Program Manager for Advanced Amphibious Assault (DRPM AAA) Program Management Office (PMO). The Marine Corps has been developing and refining amphibious doctrine since 1920, when the Commandant of the Marine Corps was told by the Chief of Naval Operations to develop a structure that would allow for the seizure of advanced naval bases. [Ref. 9:pp. 6-8] Amphibious doctrine continued to slowly evolve over the next 78 years. Amphibious assault vehicle capabilities improved as new technologies were identified.

B. AMPHIBIOUS ASSAULT

The National Security Act of 1947 stated: [Ref. 10:p. 51]

> The Marine Corps shall be organized, trained and equipped to provide fleet marine forces of combined arms, together with supporting air components, for service with the fleet in the seizure or defense of advanced naval bases and for the conduct of such land operations as may be essential to the prosecution of a naval campaign.

Section 5013 (b) of the Act states "The Marine Corps shall develop...those phases of amphibious operations that pertain to the tactics, techniques, and equipment used by the landing force." [Ref. 6:p. 1] Therefore, by law, the Marine Corps is required to maintain the ability to conduct amphibious assault operations and to develop the equipment necessary to conduct such operations.

An amphibious operation is an attack launched from the sea by naval and landing forces, embarked in ships or craft involving a landing on a hostile or potentially hostile shore. [Ref. 11] An amphibious assault is the principal type of amphibious operation, with the remaining types being a raid, a demonstration, and a withdrawal. Conducting amphibious operations is nothing new to the Marine Corps. On March 3, 1776, a short four months after the Marine Corps was established, Marines conducted their first amphibious operation - an amphibious raid on New Providence, Bahamas. [Ref. 12] This would be the first of countless successful amphibious operations conducted by the Marine Corps in its illustrious history. The Marine Corps' last major amphibious operation was the amphibious assault at Inchon, Korea in 1951 that turned the tide in the Korean War. [Ref. 12]

C. AMPHIBIOUS DOCTRINE

Although the Marine Corps has always maintained a maritime orientation, it expended little effort toward developing amphibious assault doctrine before the British disaster at Gallipoli in 1915. [Ref. 10:p. 72] Prior to this landing, the doctrine for assaulting across a defended beach had not been developed. The

difficulties encountered when assaulting across a defended or prepared beach are numerous, to include offshore mines, beach obstacles, prepared defensive positions, and emplaced defensive weapons. [Ref. 10:p. 72] The disaster at Gallipoli and the Navy's involvement in War Plan ORANGE, a contingency plan developed in 1915 for war with the Japanese in the Pacific, provided some visionary Navy and Marine Corps officers the opportunity to focus on amphibious assault operations and develop the necessary doctrine. [Ref. 10:p. 73] By 1920, the Navy recognized that in order to defeat Japan in the Pacific, they would need to capture Japanese-held islands and territories to establish advanced bases for coal and other logistic support purposes. Planning for such operations fell to the Marine Corps. [Ref. 10:p. 74]

One Marine officer who had been studying this possibility was Major Earl H. Ellis. Since 1912, Major Ellis had been convinced that the United States would eventually go to war with Japan, and that the United States would have to battle its way across the Pacific to defeat the Japanese. [Ref. 10:p. 76] Major Ellis was also convinced that the United States would have to assault Japanese-held islands in the Pacific to establish the advanced naval bases needed to win the war. After extensive study, Major Ellis wrote a study entitled "Advanced Base Operations in Micronesia" in 1920-21 [Ref. 10:p. 77]. Uncanny in its accuracy, Major Ellis outlined in detail how he saw the western drive across the Pacific occurring. He predicted the need to establish advanced support bases in the Marshall and Caroline Islands to meet the needs of the naval fleet. So thorough

was his study, it was adopted by the Joint Board of the Army and Navy and called the "Orange Plan." [Ref. 10:p. 77]

Many Marine Corps leaders agreed with Major Ellis' study. In preparation for executing the "Orange Plan," the Marine Corps held numerous training exercises throughout the 1920's designed to develop the skills necessary to conduct amphibious operations. Many worthwhile lessons learned were obtained from these early exercises, which later assisted in the initial development of amphibious doctrine. Training and equipment deficiencies were also identified during these early exercises. The need for specialized landing boats was seen as a critical equipment deficiency, a deficiency that would take over a decade to resolve. The training deficiencies could be corrected more quickly by developing amphibious doctrine. [Ref. 10:pp. 78-80]

An amphibious assault is one of the most complex military operational maneuvers. The noted British historian B. H. Liddell Hart stated that making such an assault is difficult, almost impossible. [Ref. 10:p. 72] Because of the difficulties involved in conducting an amphibious assault, writing the doctrine would not be easy. The issues that had to be addressed included: how to get equipment and weapons across any reefs and through the heavy surf; how to coordinate fire support from naval vessels and aircraft; how to coordinate the landing of assault forces across separate beaches; and how to combat load unit equipment and supplies. [Ref. 10:pp. 72-79] Fortunately for the Marine Corps, there were officers willing to tackle this monumental effort.

In 1933, all Marine Corps officers, staff and student alike, at the Marine Corps Schools in Quantico, Virginia were directed to capture in writing everything that affected the landing force during an amphibious assault. All officers received a brief on the mistakes made by the British at Gallipoli, and were provided all available information on assault landing operations, which was limited. Using his own past experiences and reasoning, each officer then wrote what he thought were the proper sequence of events for conducting an amphibious assault. After seven months of dedicated effort, the Tentative Manual for Landing Operations, 1934, was published. This manual became known as LFM 0-1. [Ref. 13:p. 34] Although it needed more work, LFM 0-1 captured the essence of the concepts related to amphibious assault and provided the framework for future refinement. Over the next several years, it was revised and updated. In 1938, the Navy adopted it as Fleet Training Publication No. 167, Landing Operations Doctrine, U.S. Navy. The Army published LFM 0-1 in 1941 as Field Manual 31-5. Little changed in either the manual itself or in Marine Corps amphibious doctrine over the next 50 years. [Ref. 10:pp. 79-82]

D. EARLY AMPHIBIOUS ASSAULT EQUIPMENT

Now that doctrine was being developed, the Marine Corps turned its focus on procuring the equipment necessary to conduct an amphibious assault. The Marine Corps needed equipment that could transport Marines, and their heavy weapons and equipment, from Navy ships to the shore. As late as the winter maneuvers of 1936-1937, the Marine Corps still had no practical way to rapidly

build up combat power ashore. [Ref. 10:p. 90] By the time World War II broke out, two pieces of amphibious assault equipment had been fielded. One was the Landing Craft, Vehicle and Personnel (LCVP), more commonly referred to as the Higgins Boat. The second was the Landing Vehicle, Tracked Model 1 (LVT-1) Amphibian Tractor, more commonly referred to as an amtrac. [Ref 14:p. 69]

1. The Higgins Boat

The Higgins boat was named after its developer, Andrew Jackson Higgins. Higgins designed his boat, called the Eureka, in 1924 for use by rumrunners in the Mississippi Delta region. The design of the Eureka, a shallow draft thirty-six foot boat with a protected propeller, allowed the boat to conduct beach landings to offload its cargo, and then retract itself. [Ref. 10:p. 92]

Higgins had tried to interest the Navy in his boat, first in 1926 and every year thereafter, but to no avail. [Ref. 10:p. 92] The Marine Corps became aware of Higgins' boat in 1934 and immediately recognized its utility in amphibious operations. After three years of Marine Corps pressure on the Navy's Bureau of Construction and Repair (later called the Bureau of Ships), the Navy finally procured one of Higgins' boats in 1937. Higgins' boat and several boats designed by the Bureau of Ships were tested during amphibious exercises in 1939 and 1940. At the end of the exercises, the Marine Corps determined that Higgins' boat best met their needs. [Ref. 10:pp. 92-94]

The prospect of going to war with Japan continued to grow. Anticipating the upcoming conflict, in 1941 the Marine Corps asked Higgins to modify his

Eureka boat to include a bow ramp for landing small vehicles. [Ref. 10:p. 94] This was an idea borrowed from the Japanese. The Marine Corps also asked Higgins to design a landing craft that could carry an eighteen-ton tank. [Ref. 10:p. 94] Working quickly, and at his own expense, Higgins modified two Eureka boats to include a bow ramp and converted an existing lighter into a landing craft, with bow ramp, capable of carrying an eighteen-ton tank. After undergoing successful evaluation by a board from the Marine Corps and the Navy, the Navy ordered two hundred of Higgins' boats. The tank-carrying landing craft designed by Higgins had a much slower route to acceptance. After a year of tests, the Higgins-designed tank landing craft won the competition and all subsequent tank carriers used during World War II were constructed using Higgins' design. [Ref. 10:p. 98] At last, the Marine Corps had a suitable landing craft for conducting amphibious assaults.

2. The Amphibian Tractor (Amtrac)

The Higgins boat went a long way toward meeting the Marine Corps' equipment needs for conducting amphibious assaults in the Pacific. However, it fell short in two critical areas. [Ref. 10:p. 100] First, the Higgins boat could not cross the coral reefs that surrounded many of the islands the Marines needed to capture. Oftentimes, the water over the coral reef was too shallow for the Higgins boat to safely cross. Additionally, the water around the reef was very choppy due to the surf breaking over the coral. Second, the Higgins boat did not provide the Marines with the capability to quickly push supplies and equipment

off of the beach, where it was vulnerable to enemy fire. This limitation proved disastrous for the British at Gallipoli, and the Marine Corps did not want to repeat this mistake. [Ref. 10:p. 100] The Marine Corps needed a vehicle capable of operating on the water (amphibious) and traversing the coral reefs and, once ashore, using tracks (tractor) to operate ashore.

The Marine Corps saw a potential solution to these problems after an article appeared in the October 4, 1937 issue of Life magazine. [Ref. 9:p. 32] The article described a vehicle that had water jets, which allowed it to operate in the water, and tracks, which allowed it to operate on land, and was capable of travelling over coral and through mud and shoal water. The vehicle, designed and built by Donald Roebling, was developed as a rescue vehicle for people lost in the Everglades or stranded by tropical storms. John Roebling, a wealthy industrialist, saw the need for such a vehicle after a devastating hurricane struck Florida in 1928, killing scores of people because no rescue vehicle existed that could navigate the Everglades or deliver needed supplies. [Ref. 10:p. 100] John Roebling directed his son, Donald, to design a vehicle that "would bridge the gap between where a boat grounded and a car flooded out." [Ref. 15:p. 54] In addition to meeting the needs of people living in the Everglades, John Roebling also saw the commercial potential for such a rescue vehicle outside the Everglades. [Ref. 9:p. 24]

In 1933, Donald Roebling began designing his water rescue vehicle, which he first tested in 1935. The vehicle, known as the "Alligator," could achieve 2.3

miles per hour on the water and 25 miles per hour on the land. [Ref. 9:p. 26] For the next two years, Donald Roebling worked to correct its many deficiencies. During this time, Roebling improved the Alligator's water and land speed, reduced its weight, enhanced its maneuverability, and increased the reliability of the track system. By 1937, Donald Roebling had built the versatile rescue vehicle that his father envisioned. [Ref. 9:pp. 24-33]

The Marine Corps began evaluating the Alligator in 1938 and soon became convinced that it could provide the combat assault capability required in the Pacific to secure advanced naval bases. The Marine Corps knew it had to act fast, as signs of war with Japan were growing. [Ref. 10:p. 102] After conducting a series of exercises over the next two years, Marine Corps representatives met with Bureau of Ships representatives and Donald Roebling to discuss the Alligator's deficiencies and to develop a production model for the new Alligator. This new vehicle, the Marine Corps' first amtrac, became known as the Landing Vehicle, Tracked Model 1 (LVT-1). [Ref. 14:p. 69] The LVT-1 could achieve 7 miles per hour on the water and 18 miles per hour on the land, and had a cargo carrying capacity of 4000 pounds. In August 1941, just six months after the production decision was made, the Marine Corps accepted delivery of its first LVT-1. [Ref. 9:p. 46]

The LVT-1 saw its first combat action in the assault on Guadalcanal in August 1942, serving primarily as a logistics vehicle transporting supplies from Navy ships to supply dumps ashore [Ref. 10:p. 105]. The LVT continued its

primary role as a logistics vehicle in subsequent amphibious assaults until November 1943, the landing at Tarawa. [Ref. 14:p. 69] For the first time, LVTs were used to transport Marines on the initial assault. Although nearly half of the LVTs were disabled by enemy fire during the assault, the LVT proved to be effective in transporting the assault force. [Ref. 10:pp. 105-108] The LVT now had a second mission – serving as an armored personnel carrier during the amphibious assault. However, the amtrac was not formally designated an assault amphibian until 1977, 34 years after proving its worth on the bloody beaches at Tarawa. [Ref. 14:p. 70]

The LVT continued to be improved and modified during World War II. One significant improvement was the addition of a stern ramp. [Ref. 14:p. 70] Stern ramps eased cargo handling, permitted the landing of small vehicles and weapons, and allowed assault forces to storm the beach straight from the LVT without having to climb over the vehicle's sides. By the end of the war, four cargo variants and two assault gun variants had been produced. All together, 18,816 LVTs were produced during World War II. [Ref. 14:p. 71]

As a testimony to the significant role the LVT played during the war, the Commanding General, III Marine Amphibious Corps, MajGen Roy S. Geiger, wrote:

> Except for the "amtracs" it would have been impossible to get ashore on Tarawa, Saipan, Guam or Peleliu without taking severe if not prohibitive losses. But, their use is by no means limited to the assault waves; after landing troops and equipment, they play an indispensable part in the movement of supplies, ammunition, et cetera, ashore. In fact, the whole ship-to-shore movement in the normal amphibious operation is to a considerable extent dependent on one or more of the "amtrac" family. [Ref. 14:pp. 73-74]

By the end of World War II, the amtrac had earned its place in Marine Corps amphibious assault operations.

3. Fielding the LVT(P)5

The amtrac once again proved itself during the 1st Marine Division's assault on Inchon and the subsequent liberation of Seoul during the Korean War. [Ref. 14:p. 74] Throughout the war, amtracs served as armored personnel carriers, logistics vehicles, and self-propelled artillery.

In 1953, the Marine Corps fielded the LVT(P)5 as the replacement for the LVT(3)C. This was the first new version of the LVT since World War II. The LVT(P)5 provided increased performance, and more importantly, included several variants. These variants consisted of recovery, command, engineer support, and fire support (105mm howitzer mounted in the turret) vehicles. [Ref. 14:p. 74]

The LVT(P)5 saw considerable action during both the Korean War and the Vietnam War, where it participated in most of the 62 landings made by Marines. During the Vietnam War, the amtracs showed their versatility once again by also serving as armored personnel carriers, logistics vehicles moving supplies across

inland waterways, patrol vehicles both ashore and afloat, and even serving in an infantry role near the Demilitarized Zone. [Ref. 14:p. 75]

4. Fielding the LVTP7

After nearly 20 years of service, the LVT(P)5 was finally replaced. In 1972, the Marine Corps began fielding the cargo version of the LVTP7 and shortly thereafter, a recovery and a command variant. Fielding was completed in 1974. No successor to the LVT(P)5 engineer support and fire support variants were produced. The LVTP7, the first water-jet propelled amphibian vehicle, provided the Marine Corps with an amphibious vehicle capable of reaching a water speed of six knots. The drawbacks to the LVTP7 included a reduced troop-carrying and cargo-carrying capacity, which was now limited to 25 troops or 10,000 pounds of cargo. [Ref. 14:p. 75]

In 1977, the LVT was renamed the Assault Amphibian Vehicle (AAV) in recognition of its mission change. The role of the AAV changed from combat service support to combat support. In addition to its role in amphibious assaults, the AAV would be used more extensively in a mechanized role during operations ashore. This would allow combat forces to take advantage of the AAV's mobility, protection from small arms fire, and protection in a Nuclear, Biological and Chemical (NBC) environment. [Ref. 16:pp. 2-3]

The planned service life of the LVTP7 was ten years. Since no replacement was ready, a Service Life Extension Program (SLEP) was begun in 1982 to extend the vehicle's service life to 1994. A Product Improvement

Program (PIP) was initiated in 1985 to improve the combat viability of the LVPT7 to the year 2004. The PIP included an automatic fire suppression system, a bow plane, an armor upgrade, and an Upgunned Weapon Station (featuring a 40mm Mk19 Mod 3 machinegun, an M2HB .50-caliber machinegun, and an M257 smoke grenade launcher). In conjunction with the SLEP, the LVTP7 was redesignated the LVTP7A1.

5. The Landing Vehicle Assault Program

The Marine Corps initiated a feasibility study in 1971 to develop a replacement for the LVTP7. In 1973 a Tentative Operational Requirement was established that identified the need for a high-speed (70 mph on water/55 mph on land) amphibious vehicle with an Initial Operational Capability (IOC) of 1986. This program became known as the Landing Vehicle Assault (LVA) program. After reviewing several alternatives to the high-speed amphibian program, the Marine Corps issued an Acquisition Decision Memorandum (ADM) in 1974 that identified the LVA as its highest priority. The Major System Acquisition Review Committee (MSARC) approved the LVA in 1975 and Feasibility/Concept contracts were awarded shortly thereafter. The contracts were awarded to FMC Corp., Bell Aerospace Textron, and Pacific Car and Foundry. Work continued on the LVA for the next several years, with Conceptual Design contracts being awarded in 1976 to the same three companies and the continued development of components for high-speed amphibians. [Ref. 17]

In 1978, the Department of Defense (DoD) approved the Marine Corps' Amphibious Warfare Surface Assault (AWSA) Mission Element Need Statement (MENS) for the LVA. As directed by the Under Secretary of Defense for Research and Engineering, the Marine Corps conducted a Cost and Operational Effectiveness Analysis (COEA) on four alternatives identified in the AWSA MENS. They were the LVA (high water speed amphibian), the Landing Vehicle Tracked (Experimental) (LVT (X)) (low water speed amphibian), an Infantry Fighting Vehicle (IFV) (brought ashore on high-speed landing craft), and an all helicopter-borne assault force. After reviewing the results of the concept studies for the LVA in 1979, the Commandant of the Marine Corps (CMC) cancelled the LVA program, citing concerns about vulnerability, affordability, and maintainability. With the concurrence of the Chief of Naval Operations (CNO), the CMC also cancelled the requirement for an Over-The-Horizon amphibious capability, stating that amphibious assaults can be launched under ten miles from shore. The LVT (X) was then chosen as the replacement for the LVA program. [Ref. 17]

6. The Landing Vehicle Tracked (Experimental) Program

The Landing Vehicle Tracked (Experimental) (LVT (X)) program had an IOC of 1986, so Conceptual Design contracts were awarded in 1978 to Booz-Allen & Hamilton, FMC Corp., Bell Aerospace Textron, and Advanced Technology, Inc. [Ref. 16:p. 3] In December 1979, the CMC approved an interim Acquisition Strategy for the LVT (X) program, establishing an IOC of 1990. An

approved Acquisition Strategy was not signed until 1983. In April 1982, the IOC was changed to 1994 in order to avoid any overlap with the LVTP7A1 SLEP. The IOC was changed again in 1983 to reflect a new IOC of 1997. In a span of four years, the IOC for the LVT (X) had slipped 11 years. [Ref. 17]

The MSARC Milestone I review, held over three sessions in 1984, was the turning point in the LVT (X) program. During the first session, three critical questions concerning the validity of the LVT (X) requirements were raised: [Ref. 16:p. 8]

> 1. In light of the development of new systems, such as the Light Armored Vehicle (LAV) and the Landing Craft, Air Cushion (LCAC), did the Marine Corps still need an Amphibious Warfare Surface Assault (AWSA) capability?
>
> 2. If the Marine Corps still needed an AWSA capability, was the LVT (X) Required Operational Capability (ROC) still valid?
>
> 3. Did the Concept Design/Sustaining Engineering contract design adequately fulfill the requirement?

After receiving answers to these questions, the MSARC recommended in October 1984 that the LVT (X) program strategy be approved, and Program Definition and Risk Reduction (PDRR) contracts awarded. The CMC gave his approval in November 1984. [Ref. 16:pp. 8-30]

Despite receiving approval to enter the PDRR phase, concerns about LVT (X) requirements persisted. In response to questions posed by the Secretary of the Navy (Research, Engineering, and Systems) in 1984 concerning the validity

of the LVT (X) requirements, the CMC provided the following program alternatives and recommendations: [Ref. 17]

1. Continue LVT (X) program with IOC of 1998 (recommend disapproval).

2. Field only the LVT (X)P (troop-carrying variant) with an IOC of 1995 (recommend disapproval).

3. Institute the Advanced Amphibious Assault Vehicle (AAAV) program (recommend approval).

After further review, the Secretary of the Navy (SECNAV) cancelled the LVT (X) program in 1985. The SECNAV determined that the marginal improvements in firepower and armor in the LVT (X) compared with the LVTP7A1 were not worth the estimated $9B cost of the new program. A ROC for the LVTP7A1 PIP was approved. More importantly, the AAAV program was designated as the new replacement vehicle for the LVTP7A1. [Ref. 17]

E. MODERN ERA OF AMPHIBIOUS OPERATIONS

During the mid-1970's, the Navy's primary role was sea control and convoy escort for the reinforcement of Europe. [Ref. 18:p. 23] The Navy was a "blue-water" navy, focused primarily on countering the Soviet threat. Little emphasis was placed on the littorals and a surface-borne amphibious assault was seen as folly given the lethality of the weapons available at that time. In fact, during the late 1970's to the early 1980's initiatives were begun to "heavy-up" the

Marine Corps to mirror existing Army divisions and move the Marine Corps away from its traditional amphibious role. Many believed a duplication of Army roles would lead to the demise of the Marine Corps.

The Iranian hostage crisis in 1979 revealed significant weaknesses in the current doctrine with regard to the United States' ability to handle small-scale contingencies. As a result, the Carter Doctrine was developed in January of 1980 as a way to resolve the problems in the Arabian Gulf region. This was the first step in the path that led to the revalidation of a global military strategy for the United States. At that time, carrier battle groups and amphibious ready groups were the only military assets capable of establishing U.S. presence in the Arabian Gulf region. [Ref. 18:pp. 23-24] The Department of the Navy's response to the changing world environment was to publish "The Maritime Strategy" in 1983. "The Maritime Strategy" addressed the role of Naval Forces in the execution of the National Military Strategy. [Ref. 18:p. 24]

1. Doctrine for Amphibious Operations Changes

In June 1985, the Chief of Naval Operations (CNO) and the Commandant of the Marine Corps (CMC) published the "Amphibious Warfare Strategy" as a subset to "The Maritime Strategy". This new strategy outlined the employment of Navy-Marine Corps amphibious forces in support of the United States' global national military strategy. [Ref. 18:pp. 24-25] The “Amphibious Warfare Strategy” stated that amphibious forces could be stationed Over-The-Horizon (OTH) at sea. [Ref. 18:p. 25] OTH meant launching the amphibious assault from 20 - 25

miles from the beach, as opposed to the previous doctrine of no more than 2.5 miles. This doctrinal change reflected the lethality that modern weapons would have on ships forced in close to shore to debark slow-moving assault landing craft.

This new strategy identified two new and then unfielded pieces of equipment, the Landing Craft, Air Cushion (LCAC) and the MV-22 tilt-rotor aircraft, as the new equipment that would be used to conduct these OTH operations. The LCAC and MV-22 were crucial because their high speed and long range provided the ability to operate from OTH while still allowing for a more rapid closure to the beach. [Ref. 18:p. 28] Not surprisingly, there was no mention in this new strategy of the AAV, an improved AAV, or the AAAV. (It is interesting to note that when the "Amphibious Warfare Strategy" was published, the LCAC had not yet been fielded and its shortcomings – inability to conduct an amphibious assault across a defended beach due to its susceptibility to even small arms fire – had not been fully identified.) Finally, the "Amphibious Warfare Strategy" did recognize that doctrinal changes were required in order to fully implement the new OTH strategy: "The formation of an operational and tactical framework for amphibious operations from over the horizon is a high priority project." The best and the brightest officers in the Marine Corps were identified to work on the project. [Ref. 18:p. 28]

2. Equipment Changes Supporting the Over-The-Horizon Doctrine

During the mid-1980's the Marine Corps recognized that its aging equipment did not support the new OTH doctrine being developed. The AAV was too slow and had limited firepower and protection. The CH-46 Sea Knight helicopter had been fielded in the 1960's and was reaching the end of its service life. So, the Marine Corps began a modernization program that allowed the Marine Air Ground Task Force to become more lethal and mobile while still maintaining their amphibious character. [Ref. 18:p. 20] The MV-22 was being developed as a replacement for the CH-46 while the AAV underwent a Service Life Extension Program (SLEP) to extend its service life to 1994. At this same time, fielding of the LCAC had begun and was revolutionizing ship-to-shore movement. Because of its high speed and payload capacity, the new LCAC caused many to question the need for a replacement amphibious vehicle.

The LVT (X) program was cancelled in June 1985 as a follow-on to the existing AAV family. The lack of a credible amphibious assault vehicle that could replace the existing AAV and offer substantial improvement in performance, namely in higher water speed, provided an additional reason for LCAC supporters to question the Marine Corps' existing amphibious doctrine. Many felt that the "traditional concepts of an amphibious assault (were) obsolete" because of the "vulnerability of ships and slow moving landing craft to modern weapons systems." [Ref. 19:p. 80] The solution lay in a high-speed method of moving Marines from ship-to-shore. The cancellation of the LVT (X) program provided

the impetus for many to express their ideas in professional journals on how to best accomplish this high-speed operation.

One idea, based on the capabilities of the LCAC, called for the "adoption of a smaller Air Cushion Vehicle (ACV) designed primarily to carry the AAV from ship-to-shore." [Ref. 20:pp. 22-23] The author felt that while AAVs were still intended to carry assault elements to the beach, they were too slow and too dependent on beach (tide and surf) conditions. Furthermore, the use of AAVs in conjunction with the LCAC would limit the future capability of the LCAC due to the AAV's slow speed. By using a new ACV to carry the AAV, the differences in speed would be overcome and would allow them to work better together. At that time, the LCAC was slated to replace all other landing craft (LCM-8 and LCU) by mid-1990.

Another concept that was discussed was creating a new Landing Ship Fast (LSF) that would be designed to carry AAVs along with 150-200 Marines and their organic weapons. [Ref. 21:p. 19] The LSF would be capable of speeds up to 75 knots in order to make a high-speed approach to the beach to allow the AAVs to debark close to the shore. The LSF was to be based on technology being developed at the time for an inter-island vehicle and passenger ferry for use between the Hawaiian Islands.

Other articles called for using the LCAC to carry the existing AAV from ship-to-shore. However, this idea had its drawbacks as the LCAC only had the deck space to carry three AAVs at a time. Unfortunately, the payload capacity of

the LCAC required that the AAVs not be fully fueled or manned with infantry Marines in order to conserve weight. This plan was not viable because the LCACs could not bring artillery and ammunition to the shore immediately behind the assault Marines in order to quickly build up combat power ashore. Others even suggested that up to 250 Marines could be brought ashore in a single LCAC but recognized the difficulties in an amphibious assault without any armor protection.

Each of these ideas was studied but results were always the same: the Marine Corps needed a high water speed assault vehicle capable of 20+ knots that could bring Marines quickly ashore. The new vehicle would also need to have improved cross-country mobility and the ability to keep up with the modern main battle tank, M1A1.

3. Beginnings of Advanced Amphibious Assault

The many problems associated with the LVT (X) program served as an invaluable source of lessons learned for other Marine Corps acquisition programs. One such lesson learned was program management. Initially, overall program management was the responsibility of the Naval Sea Systems Command (NAVSEA), who was designated as the Program Decision Authority (PDA). This responsibility was a carryover from a charter signed between the Marine Corps and the Navy during the LVA program. The Commanding General, Marine Corps Development and Education Command (MCDEC) was responsible for developing the program. As a result of this divided responsibility, the LVT (X)

Program Manager (PM) was assigned to NAVSEA but had two reporting chains. The PM reported to a Project Manager at NAVSEA and to the Director, Development Center at MCDEC. To make matters worse, no program charter had been developed. Clearly, this was not a good arrangement. Program oversight was difficult to maintain due to the number of military activities (12) and contractors (5) through which program issues needed to be staffed and coordinated. In an attempt to ease some of the program oversight problems, a memorandum of agreement (MOA) between MCDEC and NAVSEA was drafted in 1980 but never signed. The MOA established clear lines of authority and responsibility for the LVT (X) program. [Ref. 16:pp. 10-11]

In June 1985, as the LVT (X) program was transitioning from the Concept Exploration (CE) phase to the PDRR phase, the Marine Corps decided to take a more active role in managing the program. They established a Marine Corps AAV program office at NAVSEA (PMS-310) and assigned a Marine Corps program manager, known as the Project Manager, Assault Amphibian Vehicles (PMAAV), and a staff to manage AAV issues. [Ref. 16:p. 12]

When the LVT (X) program was cancelled in June 1985, the Marine Corps stated it still needed a replacement amphibious vehicle and assigned program management responsibility to PMS-310. The new vehicle was designated as the Advanced Amphibious Assault Vehicle (AAAV) but the program was not scheduled to begin until Fiscal Year 1991. [Ref. 22:p. 8]

Over the next two years PMS-310 fulfilled their tasking of further technological development in the area of high water speed for the AAAV. In 1986, as a result of taskings from PMS-310, the David Taylor Naval Research Center produced an Automotive Test Rig (ATR) and a ½ scale manned high water speed demonstrator. In 1987, a contract was awarded for a High Water Speed Technology Demonstrator (HWSTD) to AAI Corporation.

In December 1987 a Mission Area Analysis (MAA) was completed on ship-to-shore movement that identified significant operational deficiencies with the existing AAV7A1. These deficiencies covered the entire spectrum of capabilities necessary for an amphibious assault vehicle: offensive and defensive firepower, water speed, land speed, agility and mobility, armor protection and overall system survivability. [Ref. 23:p. 2] These deficiencies were identified by the Marine Corps in a Mission Need Statement (MNS) titled "Advanced Amphibious Assault" for a replacement to the AAV7A1 as part of its 1990 - 1991 Program Objective Memorandum (POM) submission in 1988. [Ref. 23:p. 2] These deficiencies resulted in the Deputy Secretary of Defense signing a Program Decision Memorandum (PDM) on 14 July 1988 approving the Advanced Amphibious Assault (AAA) as a major new Acquisition Category (ACAT) ID program. The Acquisition Decision Memorandum (ADM) was signed by the Under Secretary of Defense for Acquisition (USD (A)) on 19 August 1988. This signified the beginning of Phase 0 (Concept Exploration) of the AAA program.

The MNS submitted by the Marine Corps offered three examples of potential alternatives to the existing AAV7A1. The three alternatives were: a new high water speed amphibian, a new low water speed amphibian ferried ashore by a high-speed craft or sled, or an improved AAV7A1 (dubbed AAV7A2) ferried ashore by a high-speed craft or sled. [Ref. 17:p. 11] After reviewing these alternatives, the Defense Acquisition Board modified the MNS by tasking the Marine Corps to develop a wider range of alternatives.

4. Establishment of the Program Management Office

In March 1990, the resources of PMS-310 were consolidated and moved from NAVSEA to the Marine Corps Research, Development, and Acquisition Command (MCRDAC) (CBAV). The PMAAV was redesignated the Direct Reporting Program Manager Advanced Amphibious Assault (DRPM AAA). The new reporting chain was much more streamlined than before. The DRPM AAA now reported directly to the Assistant Secretary of the Navy (Research, Development, and Acquisition (ASN (RDA)), who is the Navy Acquisition Executive (NAE). The DRPM AAA Charter was signed by the ASN (RDA) in August 1990. [Ref. 5:pp. 1-4]

The Charter assigned the DRPM AAA responsibility for all current and future AAV programs, to include advanced development, production, modernization, conversion, and life cycle technical support. The DRPM AAA was tasked with developing a program:

> intended to design, develop, and field a cost-effective, state of the art system of AAAV's to replace the existing AAV7A1 series of amphibians. The AAAV will be a high water speed amphibian vehicle capable of independent operations in water and on land. It will provide one of the principal means of tactical surface mobility, armored protection, and offensive firepower for the landing force during both the ship-to-shore phase of amphibious operations and subsequent combat operations ashore. [Ref. 23]

Additionally, the charter mandated that the DRPM AAA be collocated with MCRDAC "to ensure an optimum working relationship." [Ref. 5:p. 5] The charter also identified AAA as the Marine Corps number one ground priority weapon system. At the time the Charter was signed, the AAA program consisted of the following five Program Elements: [Ref. 5]

1. Assault Amphibious Vehicles (AAV7A1 family)
2. AAV Product Improvements (AAV7A1 PIP)
3. Advanced Amphibious Assault (AAA)
4. Stratified Charged Rotary Engine (SCRE)
5. Marine Corps Assault Vehicles (Engineering)

The DRPM AAA remained responsible for all AAV programs until June 1993, when the AAAV and AAV programs were functionally separated. The AAV and related programs were transferred from DRPM AAA to the Commander, Marine Corps Systems Command (COMMARCORSYSCOM). [Ref. 24] COMMARCORSYSCOM was now responsible for maintaining the AAV until the AAAV was fielded. DRPM AAA could now focus all of his energies on successfully fielding the AAAV.

5. Amphibious Doctrine in the 1990's

In September 1992, the Department of the Navy published its White Paper, "...From the Sea: A New Direction for the Naval Services", which outlined a new vision for the Navy and Marine Corps. [Ref. 25:p. 19] "...From the Sea" defined the Navy's new strategy as one that has shifted "from a focus on global threat to a focus on regional challenges and opportunities." This strategic direction, derived from the National Security Strategy, represents a fundamental shift away from open ocean warfighting *on* the sea toward joint operations conducted *from* the sea. [Ref. 25:p. 19] This strategic concept was designed to carry the Navy beyond the Cold War and into the 21st Century. [Ref. 26:p. 32] One of the fundamental tenants of "...From the Sea" involves power projection. Naval forces maneuver from the sea using their dominance of littoral areas to mass forces rapidly and generate high-intensity, precise offensive power at the time and location of their choosing, under any weather conditions, day or night. [Ref. 25:p. 21] The final statement of "...From the Sea" is that the Navy and Marine Corps will "procure equipment systems to support this strategy and remain ahead of the global technological revolution in military systems." [Ref. 25:p. 22] The implication for the Marine Corps is that this new strategy wholeheartedly supports the procurement of the AAAV and the MV-22.

Two years later, in October of 1994, "...From the Sea" was updated with "Forward...From the Sea". While it did not signal any doctrinal changes, this latest White Paper reaffirmed the Navy's commitment to operations in the

littorals. Though not explicitly stated, both white papers outline a strategy that is dependent on the capabilities that will be provided by the AAAV. Without a high water speed amphibious assault vehicle, the Navy and Marine Corps will be limited in their ability to project power ashore quickly.

The strategy that does explicitly mention the AAAV is "Operational Maneuver From The Sea (OMFTS)" which was published in January 1996. OMFTS builds on "...From the Sea" and "Forward...From the Sea" and describes how the Navy and Marine Corps will combine naval and maneuver warfare to achieve decisive objectives through ship-to-objective maneuver (STOM). OMFTS is dependent on the ability of the Navy and Marine Corps to "sea-base" its command and control, logistics and the majority of fire support assets. Sea-basing will facilitate "putting the "teeth" ashore while leaving the logistics "tail" afloat, significantly leveraging land maneuver operations." [Ref. 27] In order to accomplish OMFTS, the Marine Corps will need assets that are able to leave the "sea-base," most likely loitering over-the-horizon, and reach the beach quickly. OMFTS identifies three key platforms that are required to bring the concept to reality: the MV-22 Osprey, the LCAC, and the AAAV." [Ref. 27]

F. SUMMARY

This chapter has outlined the history of the doctrine and equipment the Marine Corps has used in executing amphibious operations. Beginning in the 1930's with a rough concept on how to conduct amphibious assaults and the Higgins Boat, the Marine Corps developed doctrine and the venerable "amtrac"

that ensured the success in the Pacific Island hopping campaign of World War II. Since then, the Marine Corps has continually honed and developed both the doctrine and the equipment itself. The Marine Corps continued developing the doctrine and trying to improve on the equipment, even when many felt that the idea of conducting an amphibious assault was insane, given the lethality of modern weapons and the slow water speed of the amtrac. Now, the Marine Corps has entered into the latest era of amphibious operations. This era will be marked by over-the-horizon operations conducted by the most technologically advanced assault amphibian the Marine Corps has ever seen: the Advanced Amphibious Assault Vehicle.

The next chapter will present an overview of the standard acquisition process, discuss the initiation of the AAA program office, and will conclude with the key program management events of the AAAV program in the Concept Exploration phase and the Program Definition and Risk Reduction phase.

III. ACQUISITION PROCESS

A. INTRODUCTION

The pursuit a Major Defense Acquisition Program (MDAP) represents a significant commitment of personnel and financial resources, and is made only if no other means of meeting a warfighting deficiency is found. The path to fielding a new weapon system is very long, sometimes taking more than fifteen years. There are many places along this path where a MDAP can be delayed or cancelled. The demise of the Soviet Union as a threat caused the U.S. defense budget to be sharply reduced, with the Procurement budget absorbing a large portion of that cut. The threat may change, causing the new weapon system to be no longer necessary. Cost overruns and technical challenges may cause either the sponsoring Service or Congress to cancel the program. Finally, mismanagement of the program by the Program Management Office (PMO) can cause program delay or cancellation.

The Department of Defense (DoD) has volumes of regulations governing how a MDAP is managed. Numerous review boards and oversight committees have been formed to monitor a MDAP's progress and to detect when a program is in trouble. Despite all the regulations, review boards and oversight committees, external events can cause program cancellation, programs are still mismanaged and cost overruns still occur. There is no perfect template that can be followed to ensure that a program will succeed. Each program has its own unique challenges that must be addressed.

This chapter examines the standard system acquisition process that existed at the inception of the Advanced Amphibious Assault Vehicle (AAAV) program and the key events that occur during each phase. Next, it will look at the technology base development program begun in 1983 to identify technical solutions to fielding a high-speed amphibious vehicle. The chapter will then describe the Advanced Amphibious Assault (AAA) program and the acquisition strategies associated with the AAAV program. Finally, the chapter will examine some of the key events and decisions made by the Program Manager (PM) for the AAAV program during the Concept Exploration (CE) phase and the Program Definition and Risk Reduction (PDRR) phase.

B. STANDARD ACQUISITION LIFE-CYCLE PROCESS

This section will describe the standard acquisition life-cycle process that existed in 1988 when the AAAV program began. The researcher chose to use the existing standard acquisition process in order to highlight where the AAAV program deviated from it and to provide a basis for later analysis. However, the researcher chose to use the current terminology for each acquisition life-cycle phase to maintain consistency throughout the remainder of the thesis. Table 1 cross-references the old (1988) and the new (1999) terms for each acquisition phase.

Table 1. Cross-Reference of Old and New Terminology for Acquisition Phases

Acquisition Phase (1988 Terminology)	Acquisition Phase (1999 Terminology)
Concept Exploration and Definition (CE/D)	Concept Exploration (CE)
Concept Demonstration and Validation (Dem/Val)	Program Definition and Risk Reduction (PDRR)
Full-Scale Development (FSD)	Engineering and Manufacturing Development (EMD)
Full-Rate Production and Deployment	Production, Fielding /Deployment and Operational Support

Source: Developed by author

OMB Circular A-109 defines the system acquisition process as the sequence of acquisition activities starting from the agency's reconciliation of its mission needs, with its capabilities, priorities and resources, and extending through the introduction of a system into operational use or the otherwise successful achievement of program objectives. [Ref. 28:p. 3] The acquisition process begins when the need for a material solution is identified to meet a Service deficiency documented in the Mission Area Analysis (MAA). DOD Directive (DODD) 5000.1 directs all components to conduct continuing analysis of their mission areas to identify deficiencies or to determine more effective means of performing assigned tasks. Although not a formal phase of the acquisition process, most programs result from a MAA. Each Service assesses and evaluates its force capabilities against current and projected threat forces in order to uncover "warfighting deficiencies"; i.e., limitations or inability of the Services to perform one or more of their various broad missions; technological

opportunities to perform their missions better; or potential cost reductions. [Ref 29:p. 1.1-2] To solve this warfighting deficiency, the Service first seeks a non-material solution, such as a change in tactics, techniques, training, doctrine, or organizations. [Ref. 30:p. I-2] If the analysis shows the warfighting deficiency cannot be overcome through a non-material solution, the Service documents this material need in a Mission Need Statement (MNS). A MNS is required if the program is expected to cost more than $200M for research and development (R&D) or more than $1B for production (Fiscal Year (FY) 80 dollars). [Ref. 30:p. I-2] These thresholds are currently $355M and $2.135B respectively (FY96 dollars). [Ref. 31] Programs of this magnitude are referred to as an Acquisition Category I (ACAT I) Major Defense Acquisition Program (MDAP) and must be approved by the Defense Acquisition Board (DAB). Depending upon its final designation, ACAT IC or ACAT ID, the Milestone Decision Authority (MDA) is either the Component Acquisition Executive (CAE) for ACAT IC programs or the Defense Acquisition Executive (DAE) for ACAT ID programs. [Ref. 29:p. 1.1-1]

The MNS "identifies and describes the mission deficiency; discusses the results of mission area analysis; describes why non-materiel changes (i.e., doctrine or tactics) are not adequate to correct the deficiency; identifies potential material alternatives; and describes any key conditions and operational environments that may impact satisfying the need." [Ref. 31] Mission needs are independent of any particular system or technological solution. [Ref. 28:p. 7]

Once it is determined that a material solution is required, the Service looks at the following material alternatives in order of preference: [Ref. 30:pp. I-1-I-2]

1. Look at existing equipment to see if it can be improved through product improvement or a pre-planned product improvement.

2. Look for a commercial item or a nondevelopmental item to fill the deficiency. A Commercial Item (CI) is "any item evolving from or available in the commercial marketplace that will be available in time to satisfy the user requirement. They are any combination of items customarily combined and sold to the general public. These services are offered and sold competitively, in substantial quantities, and are available in the commercial marketplace." [Ref. 31] A nondevelopmental item (NDI) is "one that was previously developed and used exclusively for governmental purposes by a Federal Agency, a State or local government, or a foreign government with which the United States has a mutual defense cooperation agreement. NDI can require minor modification in order to meet the requirements of the agency. Items that are developed and will soon be used by the Federal, a State or local government, or a foreign government are also considered NDI." [Ref. 31]

3. Initiate a new developmental program. A new developmental program is the least preferred alternative because of the uncertainty involved in fielding a new item of equipment. Developmental cost, technical risks, political intervention, and the long time needed to develop and produce the item are

some of the reasons why a new developmental program is the least preferred alternative.

After a series of reviews, the MNS is sent to the DAB for a Milestone (MS) 0 Review. The MNS must be submitted to the DAE no later than the submission of the Program Objective Memorandum (POM) submission requesting funds for the new program. If the MS 0 review is successful, the Secretary of Defense (SECDEF), who is the DAE, issues a MS 0 Program Decision Memorandum (PDM) authorizing entry into Phase 0, the Concept Exploration (CE) phase. [Ref 30:p. I-1]

1. Phase 0 - Concept Exploration (CE)

A successful MS 0 does not constitute program initiation; it authorizes the Service to conduct concept definition studies in an attempt to define the best system concept to address the warfighting deficiency documented in the MNS. [Ref. 29:p. 1.1-2]

The CE phase, formerly known as the Concept Exploration and Definition phase, is the critical first step in finding the optimal solution to a warfighting deficiency. The purpose and scope of the CE phase include: [Ref. 30:pp. I-4-I-6]

a. Explore all alternative system design concepts within the context of the agency's mission and program objectives. Care must be taken not to develop a preconceived idea of what the "best" solution is before the studies are completed.

b. Develop a sound acquisition strategy designed to minimize the amount of time required to fulfill the need. Trade-off studies between cost and performance are conducted. Technological risk assessments are initiated and the key cost drivers and producibility factors associated with using new or immature technologies are identified. The acquisition strategy must emphasize obtaining competition throughout the acquisition process, and special emphasis should be placed on the competitive prototyping of critical components, subsystems or systems and early operational test and evaluation beginning in Phase I - Program Definition and Risk Reduction (PDRR). For an ACAT I program, the acquisition strategy must implement a competitive prototyping approach for the next phase or a waiver must be requested. [Ref. 29:p. 1.1-3]

c. The best system concept is selected following careful analysis of all system alternatives capable of satisfying the requirement. These analyses include Trade-off, Best Technical Approach, and Cost and Operational Effectiveness Analysis (COEA). The COEA compares possible alternative solutions on the basis of cost and operational effectiveness, and documents the rationale for preferring one alternative to another.

d. Appoint a Program Manager (PM) prior to the DAB MS I Review. DODD 5000.1 lists the following functions of a PM: [Ref. 30:p. I-5]

(1). Manage their program in a manner that is consistent with, and supportive of, the policies and practices contained in DODD 5000.1.

(2). Commit to an acquisition program baseline (APB). A program baseline is a formal agreement between a PM, a Program Executive Officer (PEO), and Office of the Secretary of Defense (OSD)/Service leadership. This agreement briefly summarizes factors critical to the success of a program, such as functional specifications, cost and schedule objectives and requirements, against which the program will subsequently be evaluated.

(3). Identify personnel and functional management support shortfalls that adversely affect achievement of SECDEF decisions and the approved program baseline.

(4). Promptly report all imminent and actual breaches of SECDEF decisions and the approved program baselines along with recommendations regarding future direction and action (s).

(5). Prepare and submit timely and accurate periodic program performance reports.

e. Prepare the System Concept Paper (SCP). The SCP summarizes the results of the CE phase. It describes the acquisition strategy; preferred concept for further development; reasons for eliminating alternative concepts; and establishes program cost, schedule and operational effectiveness and suitability goals to be met by the next milestone decision review.

During the CE phase, the user prepares the Operational Requirements Document (ORD), which identifies the system specific performance requirements necessary to meet the broad warfighting deficiency described in the MNS. The

PM must also put together the Integrated Program Summary (IPS), which describes the program and its estimated cost, risk and acquisition strategy, and the Test and Evaluation Master Plan (TEMP). [Ref. 29:p. 1.1-2]

Program affordability is always a concern when a MDAP is being considered. Developing good estimated program costs early in the acquisition cycle allows decision-makers to make informed cost and performance trade-off decisions. Cost estimating is one of the key activities of the CE phase and there is a number of cost estimating tools available to assist in this effort. To provide cost inputs to update the POM, the PM must develop a program life-cycle cost estimate (PLCCE) for all alternatives, and obtain both an independent cost estimate (ICE) from an activity not in the acquisition chain and an affordability assessment from the Service headquarters staff. [Ref. 29:p. 1.1-2-1.1-3] The estimates and the affordability assessment are used to judge the viability of the proposed program.

Phase 0 concludes with the MS I DAB Review. If the review is successful, the DAE issues the Acquisition Decision Memorandum (ADM). The ADM authorizes the program to proceed into Phase I; documents the SECDEF milestone decision (including approval of goals and thresholds for cost, schedule, performance, readiness and supportability); approves the acquisition strategy and establishes the Concept Baseline (of the acquisition program baseline); and establishes the exit criteria to be accomplished prior to the next milestone review. A successful MS I review constitutes program initiation. [Ref. 29:p. 1.1-3]

2. Phase I - Program Definition and Risk Reduction (PDRR)

The purpose of the PDRR phase (formerly known as the Concept Demonstration and Validation (Dem/Val) phase) is to accomplish the initial design and demonstration of the preferred system concept with particular emphasis on critical processes and technologies deemed risky in preparation for the final, detailed design activity to be conducted during the next phase. [Ref. 29:p. 1.1-3]

Major Defense Acquisition Programs (MDAPs) will be structured and resources planned to demonstrate and evaluate competing alternative design concepts. To reduce risk and to increase competition, MDAPs are required to conduct competitive prototyping unless a waiver is granted. Competitive prototyping involves having at least two contractors build prototypes for comparative testing and evaluation using cost reimbursable contracts. [Ref. 29:p. 1.1-3] OMB Circular A-109 states that "development of a single system design concept that has not been competitively selected should be considered only if justified by factors such as urgency of need, or by the physical and financial impracticality of demonstrating alternatives." [Ref. 28:p. 9]

In order to accomplish the objectives of the PDRR phase, some of the events that must occur are:

a. Award the advanced development contract to obtain a proof of design concept. Competitive development is desired in order to maintain competition in the later phases. [Ref. 30:p. I-8]

b. Conduct technical testing and user testing after the advanced development contract has been awarded and prototypes have been delivered. The material developer is responsible for conducting the technical testing, which involves significant developmental testing at the component, subsystem and system level and provides data on safety, critical system technical characteristics, ruggedization of hardware configuration, and determination of technical risks. The results of the technical testing are the basis for an Early Operational Assessment (EOA) by the independent operational test activity. [Ref. 30:p. I-9] The purpose of an EOA is to evaluate different system design features using modeling and simulation, brassboards, and prototypes. [Ref. 32] An EOA is required for an acquisition system employing low rate initial production (LRIP) [Ref. 29:p. 1.1-3]

c. Select the best prototype after reviewing cost and testing data. Down-selecting to the best prototype is necessary because fully developing two competitive models during the next phase, Engineering and Manufacturing Development (EMD), is too costly. [Ref. 30:p. I-8]

d. Update existing program-related documents, to include the ORD, COEA, PLCCE, ICE, TEMP and IPS. The PM must also update the acquisition program baseline (APB). [Ref. 30:p. I-8]

e. Address early-on supportability and producibility concerns and begin Logistics Support Analysis. [Ref. 29:p. 1.1-3]

f. Conduct a System Design Review (SDR), which results in a draft development Type B specification ("design to spec"). [Ref. 29:p. 1.1-3]

g. Identify Low Rate Initial Production (LRIP) of selected components and quantities to verify production capability. LRIP assets provide the test resources needed to conduct interoperability, live fire, and operational testing. [Ref. 30:p. I-9]

A DAB MS II Review is conducted at the end of PDRR to determine if the system is ready for Phase III - Engineering and Manufacturing Development (EMD). Primary considerations in the DAB's deliberations include:

a. Has the Service verified program affordability and adequately determined life-cycle costs? [Ref. 30:p. 1-9]

b. Did prototyping and demonstration results indicate technologies and process are attainable? [Ref. 29:p. 1.1-4]

c. Is the procurement strategy appropriate to program cost and risk assessments? [Ref. 30:p. 1-9]

d. Has program risk versus benefit of added military capability been assessed? [Ref. 30:p. 1-9]

A successful MS II DAB Review results in the program moving into Phase II - Engineering and Manufacturing Development (EMD). The MS II ADM approves entry into the EMD phase and the LRIP quantities for that phase. An updated acquisition program baseline (APB) (development baseline) is approved and the exit criteria for the EMD phase are established. [Ref. 29:p. 1.1-4]

3. Phase II - Engineering and Manufacturing Development (EMD)

The EMD phase, formerly known as the Full-Scale Development (FSD) phase, represents the third and final research phase of the acquisition life cycle. Significant resources are expended as the prototype chosen at the end of the PDRR phase is completely developed and designed down to the piece part level. The contractor who developed the best prototype during the PDRR phase has the advantage in bidding for the EMD contract. [Ref. 30:p. I-9]

Testing plays a key role during this phase. The contractor continues Developmental Test and Evaluation (DT&E) to confirm that the system conforms to contract specifications, to reduce design risk, and to determine system maturity. [Ref. 30:p. I-9] Operational Test and Evaluation (OT&E) is conducted by an independent test activity using military personnel. An independent evaluation is performed on production-representative equipment, normally using LRIP items. These items are operated and maintained in a realistic field environment by user representatives. The purpose of OT&E is to evaluate the operational effectiveness and suitability of the system and to provide data for the production decision. [Ref. 30:p. I-9]

The goals of the EMD phase are: [Ref. 29:p. 1.1-4]

a. Complete the detailed design and development of the system.

b. Demonstrate system effectiveness and suitability through operational testing.

c. Validate the manufacturing process so the system may be produced economically during Phase III - Production, Fielding/Deployment and Operational Support.

d. Approve a final "B" specification.

e. Draft the "C" (the build to specification that totally defines the design, testing, and acceptance procedures for the Configuration Item), "D" (process), and "E" (material) specifications.

As the system continues to mature, a number of important design reviews, such as the Preliminary Design Review (PDR), Software Specification Review (SSR), Test Readiness Review (TRR), and Critical Design Review (CDR) are conducted. The PDR approves the final hardware development "B" specification; the SSR approves the final software development "B" specification; and the TRR approves the software test procedures. During the CDR, the product ("C") specification, the process ("D") specification, and the material ("E") specification are drafted and system readiness for hardware fabrication and software coding is determined. [Ref. 29:p. 1.1-4]

A DAB MS III Review is conducted at the end of EMD to determine if the system is ready for the final phase of the acquisition life-cycle - Production, Fielding/Deployment and Operational Support.

An interim program review, MS IIIa, may be conducted if the "magnitude of the program is sufficiently large and/or the time between the beginning of LRIP and full-rate production is significantly long." [Ref. 30:p. I-10]

Primary considerations in the DAB's deliberations include: [Ref. 30:p. I-10]

a. Results of completed OT&E.

b. Affordability and life-cycle costs.

c. Producibility as verified by an independent assessment.

d. Cost-effectiveness or plans for competition or dual sourcing.

A successful MS III DAB Review results in the program moving into Phase III - Production, Fielding/Deployment and Operational Support. The MS III ADM approves entry into Phase III and establishes exit criteria (if warranted). The APB (production baseline) is updated. [Ref. 29:p. 1.1-4]

4. Phase III - Production, Fielding/Deployment and Operational Support

The system is now entering into the final phase of the acquisition life-cycle. This phase was formerly known as the Full-Rate Production and Deployment phase. The program transitions from development to production and deployment, which creates additional challenges for the PM. In addition to addressing any remaining performance problems, the PM must make sure that units in the field are prepared to receive the equipment. Issues related to facilities, operator and maintenance training, tools and special equipment, and initial provisioning must be dealt with prior to equipment fielding. [Ref. 30:pp. I-10-I-11) If these issues were not adequately addressed in earlier phases, the PM may find himself ready to field an item of equipment that the field is not ready to receive.

Key activities during this phase include:

a. Testing initial production items to ensure conformance to contract specifications and verify that previously identified problems have been corrected. A Physical Configuration Audit may be performed on an early production item to confirm adherence of the production item to the design documentation. [Ref. 29:p. 1.1-5]

b. Monitoring producer performance and quality through production acceptance and verification tests. [Ref. 29:p. 1.1-5]

c. Initiating system deployment to meet First Unit Equipped Date (FUED) and Initial Operational Capability (IOC). FUED is defined as "the scheduled date that the first user unit receives a new system, its agreed upon support elements, and the training specified in the New Equipment Training Plan." [Ref. 30:p. I-10] IOC is defined as "the first attainment of the capability to employ effectively a weapon, item of equipment, or system of approved specific characteristics with the appropriate number, type, and mix of trained and equipped personnel necessary to operate, maintain, and support the system." [Ref. 31]

d. Monitoring logistics supportability and readiness of newly-fielded systems. [Ref. 30:p. I-10]

5. Additional Milestone Reviews

The phases described in this section are no longer part of the acquisition life-cycle process. One to two years after the initial fielding of a new system, a

Milestone IV (Logistics Readiness and Support) Review is conducted. This review is held to ensure that operational readiness and support objectives have been achieved and maintained. [Ref. 30:p. I-11] Five to ten years after initial fielding, a Milestone V (Major Upgrade or System Replacement) Decision is conducted to determine if major upgrades to the current system are necessary or system replacement is required due to changes in the threat or new technology has made the system obsolete. [Ref. 30:p. I-11]

The acquisition life-cycle described above is the standard, text book description of the activities that normally occur in each phase. These activities do not have to occur in the phase shown above. OMB Circular A-109 states that the acquisition strategy should be tailored for each program. [Ref. 28:p. 4] Tailoring an acquisition strategy gives the PM the latitude to deviate from this cycle as long as all legal requirements are fulfilled.

C. INITIATION OF THE ADVANCED AMPHIBIOUS ASSAULT PROGRAM

The Marine Corps' Advanced Amphibious Assault Vehicle (AAAV) Program took advantage of the latitude provided by OMB Circular A-109 and tailored the program's acquisition strategy to reflect its concern over the daunting technical challenges it faced. The Marine Corps wanted an amphibious vehicle that could operate at a water speed greater than 20 knots and then transition to a land vehicle capable of travelling at least 69 kilometers per hour on a hard surface road. Efforts to procure and field a high-speed amphibious vehicle

began with the establishment of the Assault Amphibious Vehicle (AAV) Program Office in 1984.

1. Establishment of the AAV Program Office

In 1984, the Marine Corps AAV Program Office was established as office PMS-310 within the Naval Sea Systems Command (NAVSEA). A billet for a Project Manager for Marine Corps Assault Amphibian Vehicles (PMAAV) within PMS-310 was also established. [Ref. 16:p. 10] PMS-310 was responsible for maintaining the AAV and, for the first time, establishing and coordinating the technological development efforts in support of the advanced amphibious vehicles. The acquisition relationships for the PMS-310 are contained in Appendix B.

The Secretary of the Navy (SECNAV) was the Program Decision Authority (PDA) for the AAAV program. The PDA is now known as the Milestone Decision Authority (MDA). The Commander, Naval Sea Systems Command (COMNAVSEA) was assigned Head of the Contracting Activity (HCA), Source Selection Authority, and NAVSEA Program Executive Officer (PEO) responsibilities. The Commanding General, Marine Corps Development and Education Center (CG, MCDEC) was responsible for specific technology base projects. Effectively, the PMAAV had a number of bosses from NAVSEA to the Director, Development Center at MCDEC. [Ref. 16:p. 10]

The above relationship changed slightly in July 1988 when the Deputy Secretary of Defense signed the MS 0 PDM approving the AAA program as a

potential new ACAT ID major system start. The Under Secretary of Defense for Acquisition (USD (A)) became the new MDA. The USD (A) is now known as the Under Secretary of Defense for Acquisition and Technology (USD (A&T)).

PMS-310 assumed responsibility for an exploratory technology development program begun in 1983 aimed at identifying solutions to expected technical problems related to developing a high-speed assault amphibian. The Naval Surface Warfare Center - Carderock Division (NSWC-CD) was responsible for this research and development effort. [Ref. 34]

2. Technology Base Development Program

When PMS-310 was established in 1984, one of its tasks was to manage the existing technological development effort in support of the next generation amphibious assault vehicle. In 1985, the Amphibious Warfare Technology (AWT) Directorate at the Marine Corps Research and Development Command (MCRDAC) initiated a modestly funded technology base development program. [Ref. 5] The technology base development program resulted in the successful demonstration of several critical systems and subsystems, proving that a high-speed amphibious vehicle was feasible. [Ref. 4]

The Marine Corps Program Office at NSWC-CD, located in Bethesda, Maryland, executed the research and development effort. NSWC-CD was formerly known as the David Taylor Research Center. NSWC-CD had worked on the high water speed technology used in the LVA program, was familiar with naval architecture technology, and had an understanding of what the overall

technical requirements were to design a high-speed amphibious vehicle. Based on this knowledge, NSWC-CD had a vision of what a AAAV would look like and, from this vision, systematically developed key technical subsystems and integrated them in a series of advanced technology demonstrators. [Ref. 7]

The purpose of the technology base development program was to help show that a high water speed amphibian was possible, while at the same time focusing on the high "drivers" of cost, risk and performance. [Ref. 35] The known core capabilities of a high water speed amphibious vehicle were targeted for early development and demonstration before initiating an AAAV program. [Ref. 36:p. 6] The approach taken was to develop each subsystem in a competitive environment and then systematically integrate groups of technologies into successively more complex demonstrators - the Automotive Test Rig (ATR), the High Water Speed Technology Demonstrator (HWSTD), and finally the Propulsion System Demonstrator (PSD). The subsystems targeted for early development and demonstration included tracks, armor, suspension, drive train, hull and frame, and hydrodynamic systems. [Ref. 37] The culmination of the technology base development program was the integration of all subsystems into an "all-up" advanced technology transition demonstrator, the PSD. The PSD would then be tested before an amphibious vehicle concept was decided upon. The results of the technology base development program, successes and failures, were made available to industry via the Defense Technology Information

Center. [Ref. 38] As noted above, there were three key projects in the technology base development program. They were: [Ref. 39:p. 37]

a . Automotive Test Rig

The Automotive Test Rig (ATR) was the first step in the Marine Corps' quest to prove that a high water speed amphibian was feasible. The ATR was a .55 scale, 14 ton, manned land vehicle that was used to prove the feasibility of certain automotive components needed by the AAAV before the components were included in the next phase of the technology base development program. These components included a retractable hydropneumatic suspension system, lightweight band track, and a hydraulic drive train. [Ref. 39:p. 37]

Using the knowledge they gained during the LVA program, NSWC-CD "reverse engineered" the AAAV and began projects that reduced the vehicle's weight; developed a retractable hydropneumatic suspension; and developed the first "drive-by-wire" system for a combat vehicle. [Ref. 34] AAI Corporation was competitively awarded a Cost-Plus-Fixed-Fee (CPFF) contract to produce the ATR. [Ref. 34]

b. High Water Speed Technology Demonstrator

The High Water Speed Technology Demonstrator (HWSTD) was the next logical step up from the ATR. The purpose of the HWSTD was to confirm the hydrodynamic feasibility of achieving a 20-knot water speed using planing hull

technology. [Ref. 40:p. vi] The AAI Corporation was competitively awarded a follow-on CPFF contract by NSWC-CD in 1987 to produce a HWSTD. [Ref. 34]

Weighing in at 16 tons, the HWSTD was .75 scale and incorporated many of the improved components and subsystems of the ATR. [Ref. 5:p. 2] The HWSTD also introduced a bowflap, track covers and a transom flap with integrated water jets developed in-house by NSWC-CD. [Ref. 39:p. 37] The HWSTD was tested extensively from December 1989 through the first quarter of 1990 at the Surface Effects Ship Support Office (SESSO) at Patuxent River, Maryland. During testing, the HWSTD achieved water speeds of 29 knots. [Ref. 17] The HWSTD proved the feasibility of an amphibious vehicle achieving water speeds over 20 knots.

c. Propulsion System Demonstrator

The Propulsion System Demonstrator (PSD), a .90 scale, 29 ton armored amphibious vehicle, was the final step in the technology base development program. The objective of the PSD was to demonstrate the feasibility of attaining 17 knots over water in a full-scale troop-carrying armored vehicle. [Ref. 41] While the ATR and the HWSTD demonstrated land automotive and waterborne capabilities, they were not armored and were not capable of carrying personnel other than the driver and a test engineer. The PSD, on the other hand, was armored and could carry a crew of three along with sixteen infantry. The PSD was a <u>demonstrator</u> vehicle, not an AAAV prototype. [Ref. 41] The contract for

the PSD was a competitively awarded CPFF contract that went to the AAI Corporation. [Ref. 34]

The PSD, tested at SESSO on the Patuxent River in the Fall of 1991 through March 1992, achieved a top water speed of 28.7 knots. [Ref. 5:p. 2] A concept feasibility demonstration of the PSD was held on 12 February 1992 on the Potomac River, near the Washington Monument. Attending this demonstration were a number of Defense Acquisition Board principals and staff members from the USD (A) office as well as the DON. Attendees included the Head of the Conventional Systems Committee (USD (A)), Mr. Kendall; the Director of Land Warfare (USD (A)), Mr. Viilu; the Director of Naval Warfare (USD (A)), Mr. Martin; the ASN (RDA), Mr. Cann; the CMC, General Mundy; and several members from the Office of the Secretary Defense Program Analysis and Evaluation office and the Cost Analysis Improvement Group. During the two demonstrations held that day, the PSD successfully demonstrated its maneuverability and high water speed capability. The PSD then demonstrated its ability to reconfigure itself from a sea-mode to a land-mode vehicle and drove up the ramp at the Bolling Air Force Base yacht basin to provide the observers a first-hand look at the PSD. [Ref. 42] These successful demonstrations helped prove that the concept of a high water speed amphibious assault vehicle was indeed feasible.

3. Initiation of the Advanced Amphibious Assault Program

In December 1987 a Mission Area Analysis (MAA) was completed on ship-to-shore movement that identified significant operational deficiencies with the existing LVTP7A1. These deficiencies were identified by the Marine Corps in a Mission Need Statement (MNS) titled "Advanced Amphibious Assault" for a replacement to the LVTP7A1 as part of its 1988 Program Objective Memorandum (POM) submission for FY90 and FY91. [Ref. 5:p. 2] After receiving program approval by the Conventional Systems Committee, the DAB, and the Defense Resources Board, the Deputy Secretary of Defense signed the PDM on 14 July 1988. [Ref. 17] The PDM approved the Advanced Amphibious Assault (AAA) as a potential new ACAT ID major system program. The ADM was signed by the USD (A) on 19 August 1988. [Ref. 17] The ADM signified permission to enter into Phase 0 (Concept Exploration) of the AAA program.

The MNS submitted by the Marine Corps offered three examples of possible alternatives to the existing LVTP7A1. The three alternatives were a new high water speed amphibian (AAAV), a new low water speed amphibian ferried ashore by a high-speed craft or sled, or an improved LVTP7A1 (dubbed AAV7A2) ferried ashore by a high-speed craft or sled. [Ref. 17:p. 11] After reviewing these alternatives, the DAB modified the MNS and tasked the Marine Corps in the ADM to develop a wider range of alternatives. [Ref. 43]

4. Original AAAV Program Acquisition Strategy

In October 1988 the AAAV program published its first Acquisition Plan - NAVSEA 88-043. An acquisition plan focuses on the procurement and contracting processes to implement the acquisition strategy. [Ref. 31] This Acquisition Plan (with Revision 1) was later redesignated DRPM, AAA Acquisition Plan 90-002 in March 1991. The PM was tasked with developing a program:

> ...intended to design, develop, and field a cost-effective, state of the art system of AAAV's to replace the existing AAV7A1 series of amphibians. The AAAV will be a high water speed armored amphibian vehicle capable of independent operations in water and on land. It will provide one of the principal means of tactical surface mobility, armored protection, and offensive firepower for the landing force during both the ship-to-shore phase of amphibious operations and subsequent combat operations ashore. [Ref. 23:p. 1]

The original acquisition strategy called for up to three CE phase Firm-Fixed-Price (FFP) contracts, using full and open competition, to be awarded in October 1989. The principal products of the CE phase were conceptual studies (design and trade-off analysis), conceptual designs with a full-scale mock-up of each design, 1/8 scale or larger tow tank test model, and armor samples of each proposed design. The MS I Review was scheduled for 2nd quarter FY91. [Ref. 23:p. 3]

The PDRR phase was scheduled to begin 2nd quarter FY91. Cost-Plus-Fixed-Fee (CPFF) contracts were to be awarded, through limited competition, to two of the three CE contractors for the design and fabrication of one to two AAAV

personnel (P) variants per contractor. The design and fabrication would be based on the system specifications the contractor developed during the CE phase. Preparing designs for other mission role variants, such as communication and recovery, was also a possibility. Developmental Testing (DT) and Operational Testing -1 (OT-I) testing was scheduled for nine months beginning in the 2nd quarter of FY93. Testing was scheduled to be completed and results prepared in time for a MS II Review in the 1st quarter FY94. [Ref. 23:p. 3]

The EMD phase was scheduled to last four years, from 1st quarter FY94 until the 1st quarter FY98. A single competitive Cost-Plus-Incentive-Fee (CPIF) contract for EMD would be awarded, through limited competition, to one of the two PDRR contractors. The award would be based upon the results of the prototype tests, an assessment of their overall PDRR effort, and a complete evaluation of their EMD proposal. Fifteen prototypes would be built and tested. DT/OT-II testing would occur over a two-year period, beginning in the 4th quarter FY95 and concluding in the 4th quarter FY97. The tests would be structured to ensure that all required specifications have been met. The final EMD product would be a level 3 technical data package (TDP). A MS III Review was scheduled for the 2nd quarter FY98. [Ref. 23:p. 5]

The Production, Fielding/Deployment and Operational Support phase would begin with the awarding of a competitively awarded, fixed-price type contract to one contractor for the fabrication of 1400 vehicles and their

associated provisioning items. The level 3 TDP could be used if additional vehicles were required to meet Foreign Military Sales (FMS) or another Service's requirements. The level 3 TDP would provide the flexibility to use dual sourcing or leader-follower contracting strategies. [Ref. 23:p. 6] IOC was scheduled for 4th quarter FY99 and Full Operational Capability (FOC) would be achieved in FY03 or FY04. [Ref. 44:p. 4]

5. Revised AAAV Program Acquisition Strategies

An acquisition strategy is a working document that is routinely revised as additional information becomes available, the system matures, and milestones are passed. The Program Office at PMS-310 was consolidated with resources from MCRDAC and the PM was redesignated as the Direct Reporting Program Manager Advanced Amphibious Assault (DRPM AAA) on 1 June 1990. A new acquisition strategy, DRPM AAA 90-002, was published in March 1991. This new document revealed some significant changes in the acquisition strategy, particularly in the later phases. In addition to the previous CE phase contract deliverables, the contractors were also required to identify the functional system specifications related to their concept. [Ref. 45:p. 4] A MS I Review was still scheduled for May 1991. [Ref. 46:encl. 2]

The acquisition strategy for the PDRR phase showed that the DT/OT-I testing would now cover a twelve-month period beginning in December FY95. [Ref. 46:encl. 2] This represented three additional months of testing and a 21-month schedule slip from the original acquisition strategy. The two contracts for

the PDRR phase would now be competitively awarded through full and open competition rather than limited competition as initially planned. [Ref. 45:p. 5] The MS II Review was now scheduled for 2nd quarter FY96, a 27 month schedule slip. [Ref. 46:encl. 2]

The EMD phase was now scheduled to last 55 months, an increase of seven months from the original acquisition strategy. The MS III Review was now scheduled for 2nd quarter FY01, a three year schedule slip. [Ref. 46:encl. 2] The number of prototypes required was increased from 15 to up to 25 and the design, fabrication and testing of a communications mission role variant was now required. [Ref. 45:p. 6]

The acquisition strategy for the Production, Fielding/Deployment and Operational Support phase now included the possibility of an LRIP requirement and called for the delivery of up to 2,000 AAAVs, and the associated support equipment and required spare parts. The increase in the number of AAAVs was due to anticipated FMS. [Ref. 45:p. 6]

The AAAV acquisition strategy continued to evolve over the next several years. The MS I Review originally scheduled for May 1991 was finally held in March 1995. After successfully passing the MS I Review, a new acquisition plan, DRPM AAA 95-1, was approved in April 1995. [Ref. 47] The new plan was a complete revision of the existing plan, which was nearly four years old, and was focused on the PDRR phase. [Ref. 47:p. 1] Acquisition Plan DRPM AAA 96-1 was signed in June 1996, with the changes primarily involving the schedule and

funding. [Ref. 48:p. 1] This acquisition plan was revised again in March 1997 with the publication of Revision 01. Revision 01 covered engineering efforts designed to accelerate design maturation prior to the PDRR Interim System Review-1. [Ref. 49:p. 1]

The milestone schedule contained in acquisition plan DRPM AAA 95-1 allowed for a thirty-month fabrication phase, six months for combined shakeout/acceptance tests, eight months for DT-I, one month for refurbishment, and three months for OT-I. [Ref. 47:p. 10] The forty-eight months allotted to testing in the PDRR phase is six-to-10 times longer than what was used during the PDRR phase for the X-M1 tank. [Ref. 47:p. 10] The acquisition plan also identified several acquisition streamlining initiatives the PM was pursuing. These initiatives included using commercial specifications and standards in place of military specifications and standards; having the prime PDRR contractor draft statement of work (SOW) for the EMD, LRIP and production contracts; and maximizing the use of Nondevelopmental Items. [Ref. 47:p. 13] The acquisition plan stated that a "Best Value" source selection technique would be used and a Cost-Plus-Award-Fee (CPAF) contract would be awarded rather than a CPFF contract. [Ref. 47:p. 26]

One example of a significant change from the original acquisition strategy is that only one contractor, GDLS, was awarded the contract for the PDRR phase instead of the two originally planned. Another example is the scheduled date for IOC and FOC. The original acquisition strategy published in 1988 showed IOC

scheduled for 4th quarter FY99 and FOC scheduled for FY03 or FY04. As of August 1998, IOC was scheduled for February 2006 and FOC in August 2012. [Ref. 50] These are just two examples of how an acquisition strategy can change over the years.

6. Evolutionary Acquisition Strategy

The Marine Corps pursued an "evolutionary acquisition strategy" for fielding the AAAV rather than following the traditional acquisition process. Convinced that the current acquisition model was too cumbersome and inefficient, the Marine Corps proposed an alternate acquisition strategy to Dr. Perry, Deputy Secretary of Defense, and Dr. Deutch, USD (A&T), in June and July of 1993 respectively. [Ref. 36:p. 7]

The acquisition reform movement within the DoD was underway and the Marine Corps saw the opportunity to break away from the standard acquisition model. The evolutionary acquisition strategy called for focusing on the development of the "core" capabilities of the AAAV, and fielding the AAAV as soon as the core capabilities were reached. The core capabilities were in the areas of water speed, land mobility, firepower, and survivability. [Ref. 36:p. 8] The contractor would be required to design in space, weight, power claims, channels, hard points, etc. to allow new technologies to be incorporated after the core system had been fielded. [Ref. 36:p. 7] The evolutionary acquisition strategy differed from the traditional acquisition strategy of "getting it all at once." In other system developments, this traditional strategy often resulted in

equipment being fielded that contained components that were obsolete or nearly obsolete and resulted in extremely long CE, PDRR, and EMD phases. [Ref. 36:p. 7] The evolutionary acquisition strategy sought to put the AAAV into the hands of Marines more quickly while allowing for future technical advances.

The evolutionary acquisition strategy envisioned by the Marine Corps required the support of the DoD. The Marine Corps was asking the DoD to approve a "Paradigm Shift" that allowed the AAAV program to apply a "value-added" litmus test to existing DoD acquisition policies. [Ref. 36:p. 7] The litmus test involved evaluating the policies contained in the DoD 5000 series of directives, and those directives that did not add "value" to the program would not be followed as long as no public laws were violated. [Ref. 36:p. 7] To be successful, the "Paradigm Shift" required DoD support in three critical areas: [Ref. 36:p. 8]

1. Sponsorship from the highest levels of the DoD.
2. Streamlined decision-making.
3. Program stability.

Without support in these three critical areas, acquisition reform and the evolutionary acquisition strategy would not work.

The evolutionary acquisition strategy also required the contractor to perform a "Paradigm Shift." The contractor would be expected to assume more risk and identify risk-reducing measures early in the program; produce prototypes sooner; perform concurrent engineering; use more modeling and simulation

during the design and development phases; and work on the end product from the beginning. [Ref. 36:p. 8] Industry would have to undergo a "Paradigm Shift" similar to the DoD.

The Marine Corps thought that implementing the evolutionary acquisition strategy would result in IOC being achieved in 2000 and FOC in 2004, five years earlier than was currently being projected in the acquisition baseline. Appendix C shows a comparison of the current acquisition baseline and the evolutionary acquisition strategy baseline.

D. PHASE 0 - CONCEPT EXPLORATION

The AAAV program entered the Concept Exploration (CE) phase upon publication of the MS 0 PDM in July 1988. The ADM, published the following month, directed the Marine Corps to "examine alternatives of placing infantry ashore, not just a new amphibious vehicle." [Ref. 43] The program was officially named "Advanced Amphibious Assault" (AAA) to reflect the expanded scope of its pursuit for a solution to the ship-to-shore portion of the Over-The-Horizon (OTH) doctrinal concept. [Ref. 43]

The purpose of the CE phase is to identify a specific system concept or concepts for development in later phases. During this phase, a number of study contracts are awarded to private industry for the exploration of possible alternatives to meet the stated mission need. A number of activities are completed and documentation and analysis prepared for the MS I decision. The requirements activity prepares the COEA, which compares possible alternative

solutions on the basis of cost and operational effectiveness, and documents the rationale for rating one alternative to another. Cost estimating is one of the key activities of this phase. The PM must develop a program life-cycle cost estimate (PLCCE) for all alternatives and obtain both an independent cost estimate (ICE) from an activity not in the acquisition chain and an affordability certification from the Service headquarters staff. All these estimates are to be used to judge the proposed program and to provide cost inputs to update the Program Objective Memorandum (POM). The user also prepares the Operational Requirements Document (ORD), which documents the more specific performance requirements necessary to eliminate the broad warfighting deficiencies described in the MNS.

As a result of the progress being made in the technology base development program, the high water speed approach was determined to be technically feasible. [Ref. 5:p. 2] However, it was realized that there were other system approaches that could be taken to satisfy the necessary performance requirements. [Ref. 5:p. 2] These different approaches would be evaluated during the CE phase.

The CE phase of the AAAV program can be divided into two parts. The first part defined the problem and explored different alternatives while the second part exploited the knowledge gained during the technology base development program and applied to the COEA's preferred alternative, thus reducing technical and cost risk prior to actual program initiation (MS I).

1. Part One

The problem tackled during this part of the CE phase was centered on the system mission. The first set of contracts was awarded to UDLP (formerly FMC) and GDLS in February and April 1990 respectively. [Ref. 5:p. 2] These were Firm-Fixed-Price (FFP) contracts and were awarded for $1.5M each. The contracts were awarded by the NAVSEA contracting officer supporting PMS-310.

The purpose of the first set of contracts was to gain industry input into the different technical approaches and cost uncertainties. [Ref. 5:p. 2] Under these first study contracts, UDLP and GDLS were tasked with developing concept designs, cost estimates, development plans, tow tank test models of their proposed design, providing armor samples, and building a full-scale mock-up. [Ref. 51]

As the CE phase progressed, the first COEA was completed in March 1991. [Ref. 35] The COEA evaluated 13 different alternatives that included high water speed amphibians, low water speed amphibians, non-amphibians (e.g. armored personnel carriers, infantry fighting vehicles), and non-vehicles (e.g. all air via helicopter or all surface via LCAC). [Ref. 35] The results of the COEA clearly showed that the AAAV was the overall superior choice by a considerable margin. [Ref. 52] Additionally, the AAAV was found not to be the most expensive alternative as many had expected. [Ref. 52] See Appendix D for additional details on the CE COEAs.

2. Part Two

In the Spring of 1991, the PM felt that the program was prepared for the upcoming MS 1 DAB Review, which was scheduled for 29 May 1991. In preparation for the review, the MS I Review process began on 11 April 1991 with the Marine Corps Program Decision Meeting (MCPDM). [Ref. 53] At this meeting, the ASN (RDA), expressed his concerns about the plan to test two prototypes during the PDRR phase, and then at the end of the PDRR phase, select the best features of each to produce a new specification for competition in the EMD phase. The ASN (RDA) was also concerned about the maturity of engine development. [Ref. 53] The result of the MCPDM was that the ASN (RDA) requested that the program conduct an independent technical assessment prior to moving further through the MS I DAB Review process. [Ref. 53] The assessment would evaluate the perceived technical risks associated with the new AAAV. [Ref. 54:p. 1] As a result of these issues, as well as some others, it was decided that the program was not ready to proceed to the MS I DAB Review and a postponement was necessary. The ASN (RDA) requested a postponement, which was granted by the DAB. [Ref. 53] The MS I DAB Review was finally held in March 1995, a program slip of nearly four years. [Ref. 47:p. i]

Program affordability also became an issue in 1991. In November 1991, the CMC directed the PM to investigate lower cost development and production strategies. [Ref. 55] Two new alternatives/strategies, known as AAAV "Modular" (AAAV(M)) and AAAV "Block Upgrade" (AAAV(V)), were developed in December

1991/January 1992. [Ref. 55] The two alternatives were similar in that they both contained a mix of 205 high water speed and 746 slow water speed amphibious vehicles. [Ref. 56:p. vii] The high water speed variant would meet all of the requirements of the Operational Requirements Document (ORD), while the slow-speed variant would meet all of the requirements of the ORD except the high water speed. [Ref. 56:p. vii] The AAAV(M) strategy used a traditional new vehicle development approach with an imbedded modular design. A new low-speed amphibious vehicle would be built with the high-speed attributes of weight, space and required structural design imbedded. Later, when the high water speed specific components were designed and produced, they would be installed into the vehicle. [Ref. 57:p. 411] The AAAV(V) block upgrade strategy used the existing AAV7A1. The deficiencies of the AAV7A1 were prioritized and when material solutions to the deficiencies were found, the new technology would be inserted into the AAV7A1. [Ref. 57:p. 411] The COEA was expanded in February 1992 to evaluate these new alternatives. [Ref. 55] Over the next year, the second COEA carefully analyzed the AAAV(M) and the AAAV(V) alternatives. Although both alternative strategies had some limited merit, the second COEA determined that the AAAV was still the most operationally and cost effective alternative. [Ref. 58]

a. First "Red Team" Assessment

After the MCPDM, the ASN (RDA) tasked the Office of Naval Research's (ONR's) Office of Advanced Technology (OAT) to conduct an

independent "Red Team" assessment of UDLP's and GDLS' AAAV designs and the program. [Ref. 54:p. 1] The "Red Team" assessment, completed in July 1991, identified three chief areas of technical risk regarding the two contractors' designs. These areas were vehicle weight, vehicle engine power as it relates to achieving high water speed, and the vehicle hydropneumatic suspension system. OAT made seven recommendations for mitigating or eliminating the risk. [Ref. 54:p. 1] The OAT recommended that the AAAV program continue all ongoing development efforts that support the program; immediately initiate an aggressive weight reduction program; conduct additional engineering analyses to further define the work that needed to be done in the PDRR phase; tailor the PDRR Request for Proposal to allow for design flexibility to accommodate alternatives for high risk components; demonstrate all high risk technologies prior to full-scale prototyping; continue ongoing advanced development programs; and defer concept down-selection until the recommended analyses are completed. [Ref. 54:p. 35]

Following the "Red Team" assessment, the PM awarded UDLP and GDLS follow-on contracts that focused on conducting technical risk-reduction projects. [Ref. 54:p. 1] The follow-on CPFF contracts were awarded in September 1991. Since these contracts were not competitively awarded, a class Justification and Approval (J&A) was approved by the ASN (RDA). [Ref. 59] The MCRDAC Contracting Officer supporting the PM awarded these contracts.

These contracts are discussed in more detail in the upcoming section on risk-reduction projects.

b. Second "Red Team" Assessment

In 1992, ONR conducted a second "Red Team" technical assessment, which was completed in November 1992. [Ref. 35] This assessment evaluated each contractor's new AAAV design and the results of their technical risk-reducing activities. [Ref. 54:p. 2] Their assessment included the following findings and recommendations: [Ref. 35]

- The risk-reducing initiatives and action taken by the AAAV Program Office since the ONR July 1991 technical assessment had resulted in the elimination of high risk areas in both the UDLP and GDLS baseline concepts for the AAAV.

- The PMO should initiate full-scale prototype design, development and testing.

The final set of CE contracts was awarded to GDLS and UDLP in July 1993. These non-competitive follow-on contracts were CPFF contracts awarded by MCRDAC. The purpose of these contracts was to have both contractors continue their risk-reduction projects and to build and test an Automotive Test Rig. [Ref. 60]

3. Risk-Reduction Projects

The early identification and mitigation of technical risks are crucial to a program's eventual success. Technical risks that are not identified or mitigated until later phases of a program will result in increased program costs, delays, and may result in program cancellation. The Navy's A-12 program is an example of a program being cancelled due to technical risks not being identified and mitigated early in the program. The standard acquisition model that existed at the time the AAAV program began called for most of the technological risk-reduction measures to occur during the PDRR phase, not during the CE phase.

The PM recognized the risk involved in waiting too late to address the technical risks facing the program, particularly those identified during the "Red Team" assessments. To mitigate these technical risks, the PM began several risk-reduction projects during the CE phase. The risk-reduction projects included: [Ref. 37]

1. Water propulsion experiments
2. Electric drive experiments
3. Hydrodynamic Test Rigs
4. Automotive Test Rigs
5. Appendage Actuation/Robustness experiments
6. Armor testing/repairability

The first "Red Team" assessment resulted in risk-reduction contracts being awarded to GDLS and UDLP for the fabrication and testing of near full-

scale hydrodynamic test rigs; weight reduction efforts; prototype waterjet fabrication and testing; fabrication and live-fire testing of armor solutions; vehicle hydrodynamic analyses; and appendage robustness testing and analyses. These activities resulted in design changes that reduced vehicle weight, eliminated the electric drive and the use of propellers, and added a margin on thrust. These activities also resulted in the PM adopting an open engine bay architecture philosophy, whereby the AAAV could accept primary and alternate engine technologies. [Ref. 54:p. 1] The open engine bay architecture design requirement ensured that any candidate engine could be installed in the AAAV without incurring additional costs to rearrange internal vehicle subsystems and components. [Ref. 61:p. 1] The design and development of an engine capable of producing sufficient horsepower to achieve the desired high water speed was one of the most technically challenging problems facing the program.

The second "Red Team" assessment resulted in additional risk-reduction contracts being awarded to GDLS and UDLP. These projects focused on simplifying appendage mechanisms or eliminating them altogether, and continued engine development. The result of these latest risk-reducing projects was the elimination of some system appendages and the decision not to use a gas turbine engine. [Ref. 54:p. 2]

The risk-reduction projects discussed above, as well as other projects initiated by the PM, resulted in the elimination of all "High" or "Moderate-High" risk assessments in the AAAV MS I Integrated Program Summary Risk

Assessment. [Ref. 54:p. 3] The program office credited OAT's "Red Team" assessments as being critical in the mitigation and elimination of technical risks in the AAAV design.

4. Program Stability

Program stability was one of the three critical requirements needed to achieve the "Paradigm Shift" sought by the Marine Corps to implement its evolutionary acquisition strategy for the AAAV program. [Ref. 36:p. 8] Two crucial areas of program stability are funding and personnel. A decrease in program funding has a ripple effect throughout a program. Program cuts cause problems not only for the PM, but also for the contractors competing for or developing a new system. Personnel turnover, especially at the management level, is also a concern. Loss of institutional knowledge and a lack of continuity adversely affect a program.

a. Program Funding

The stability of program funding is a key concern for any PM. As the defense budget continued to decline in the early 1990's, programs were at increased risk for sudden cuts in their current and future year program funding. This uncertainty added to the cost of programs as contractors sought to cover costs resulting from program starts and stops. Such funding reductions can result in the program schedule being stretched out, a reduction in performance requirements, and/or a decrease in the quantity of systems purchased.

The AAAV program suffered its first significant funding cut in December 1994 with the issuance of PDM-4. PDM-4 reduced the original FY96-01 Research, Development, Test and Evaluation (RDT&E) funding stream by $190M, a 35% reduction from the FY 1996 President's Budget. The cuts would cause an already long program to be stretched out an additional 30 months. [Ref. 62:p. 1] The budget cuts were apportioned as follows: [Ref. 63]

Table 2. Impact of PDM-4 Budget Reduction on AAAV Program Funding

	FY96	**FY97**	**FY98**	**FY99**	**FY00**	**FY01**	**TOTAL**
FY 1996 Presidential Budget (in $M)	66.0	85.6	93.4	59.4	104.9	134.2	543.5
PDM 4 Cut (in $M)	-33.5	-54.1	-41.7	+26.6	-11.9	-75.2	-189.9
Resulting Budget (in $M)	32.5	31.5	51.7	86.0	93.0	58.9	344.6

Source: Developed by Author

These cuts were to take effect during the PDRR phase, and could adversely affect planned tests (such as engine, ballistic hull, armor qualification and communications suite tests), requirement trade studies, and delivery of prototypes. Not only would the development and fielding schedule be stretched out further, the PM had to find $190M in program savings.

On 30 September 1995, PDM-2 was signed and it added $107M back into the FY97-01 AAAV program budget. It also directed that the IOC be changed from FY08 to FY07. [Ref. 64] The additional $107M only bought back

nine months of the 30 months lost due to PDM-4. The Fiscal Year 1996 House National Security Committee Report 104-131 directed "the SECNAV to identify the additional funding needed to restore the original schedule with the submission of the Fiscal Year 1997 budget request." [Ref. 62:p. 3] SECNAV estimated that it would cost an additional $113.65M between FY97-02 to "buy back" the original schedule. [Ref. 62:p. 3]

b. Personnel Stability

Maintaining personnel continuity within an organization has both advantages and disadvantages. The advantages include intimate knowledge of critical issues and problem areas, improved long-range planning, more effective information flow, and a reduction in the time lost "reinventing the wheel." Disadvantages include increased bureaucracy, an unwillingness on the part of some employees to try something new, and "turf" protection by entrenched employees.

The PM for most MDAPs is a military officer who typically spends no more than four years with a program that can easily span 10-15 years. The 1990 Defense Acquisition Workforce Improvement Act (DAWIA) has gone a long ways toward improving the professional qualifications of PMs but it did not resolve the military personnel turnover problem. The PM depends on the civilian members of the program office to provide the continuity but they lack the field experience and operational expertise that the military officer brings to the program. Retaining key civilian personnel can also be a problem due to the lack

of upward mobility within the program office. Civilian personnel looking for advancement may have to move to another program office. To remain effective in a fast-paced and fluid environment, the program office must form a cohesive team quickly as new key members arrive. Retaining the right personnel in key billets throughout the program will help keep the program on track and out of trouble.

5. Early Operational Assessments

Early operational assessments (EOA) are normally conducted in the PDRR phase. [Ref. 29:p. 1.1-3] An EOA is an operational assessment conducted prior to, or in support of, MS II and its purpose is to evaluate different design features. [Ref. 29:p. 1.1-3] However, the AAAV program conducted two Fleet Marine Force EOAs during the CE phase. [Ref. 57:p. 413]

The two EOAs were conducted on each contractor's full-scale mock-up to evaluate safety, training, maintenance, operational requirements, and other human factor issues. [Ref. 57:p. 413] These early EOAs allowed the program office and the contractor to identify design problems sooner in the acquisition process, when design changes would be easier to implement, thereby avoiding costly design changes later on when prototypes were built.

E. PHASE I - PROGRAM DEFINITION AND RISK REDUCTION

The AAAV program entered into the PDRR phase in March 1995 after passing the MS I Review. The PM would confront new challenges during this

phase as the AAAV program continued to move forward. Prior to entering the PDRR phase, the PM made some decisions concerning down-selecting to one contractor for the PDRR phase, how to prevent contractor "buy-in," Government and contractor collocation, and teaming. A discussion of each of these issues follows.

1. Down-Selection to One Contractor

Under the standard acquisition model, down-selecting to the best prototype did not occur until the end of PDRR. [Ref. 30:p. 8] The PM wanted an exception to the Competitive Prototyping Requirement of Title 10, United States Code, Section 2438 in order to down-select to one contractor for the PDRR Phase. [Ref. 65] This request would be based on the fact that the Government had extensive knowledge of amphibious vehicles and the technology base that had already been developed. Additionally, the two competing AAAV designs were not fundamentally dissimilar from each other or from the Government's own earlier technical base designs. Down-selecting to only one contractor at the end of CE would allow the full extent of the Government's experience to be imparted on the single prime contractor. [Ref. 65] One drawback to having only one contractor during the PDRR phase is the lack of competition for the prototype design. The PM had to find a way to achieve an acceptable level of competition.

After a comprehensive source selection process, GDLS was chosen as the sole contractor for the PDRR phase. [Ref. 66] Competition would be maintained by using a CPAF contract in the PDRR phase rather than a CPIF

contract; maximizing competition at the component and subassembly level since the prime contractor is primarily a system level designer and a subsystem integrator; and maintaining an open architecture philosophy for technically risky or expensive subsystems. [Ref. 67:p. 29]

The PM recognized that during the PDRR phase, when critical design decisions were being made, a contractor had no incentive to make beneficial design improvements that increased costs now but resulted in cost savings later on. The PM wanted a way to incentivize the contractor to make design decisions now that would result in lower life-cycle costs or design-to-unit-production cost savings. [Ref. 7] To help achieve these long-term cost savings, the PDRR contract contained clause H-19, titled "Special Provision Regarding AAAV System Design Decisions." A copy of this clause is contained in Appendix E.

The AAAV System Design Decision provision incentivizes the contractor to propose design changes now that result in long-term cost savings by making equitable adjustments to the current contract. The equitable adjustment would reflect the contractor's anticipated increase in PDRR costs (including Facilities Capital Cost of Money (FCCM) and fee) resulting from the design change. [Ref. 67:p. H-30] The PM was willing to pay more in the PDRR phase in order to realize increased life-cycle cost savings later. The burden was on the contractor to prove that the benefits from the design change substantially outweigh the additional cost. [Ref. 69:p. 40]

The PM office provided three examples of anticipated long-term cost savings resulting from the AAAV System Design Decision provision. In the first example, a trade study determined that a competing Hydrodynamic Suspension Unit (HSU) designed by a GDLS competitor offered better reliability, improved performance, and weighed less when compared to GDLS' HSU. [Ref. 70] Switching to the competitor's design would increase the cost of the current contract by $2M but would result in a life-cycle cost savings of over $242M. The design change was approved by the PM. [Ref. 70]

In the second example, a trade study was conducted that compared the baseline transmission, a unique four-speed transmission built by Allison Transmissions, with a common six-speed transmission also built by Allison Transmissions. [Ref. 70] The trade study concluded that the six-speed transmission provided greater efficiency and performance. [Ref. 70] Switching to the six-speed transmission would increase the cost of the current contract by $3.5M but would result in a life-cycle cost savings of over $71M. This design change was also approved by the PM. [Ref. 70]

In the third example, a trade study showed that a filter design that was common in the Army equipment was more reliable and weighed less than two other alternatives. [Ref. 70] Switching to the common filter design would increase the cost of the current contract by $390K but would result in a life-cycle cost savings of $3.2M. This design change was also approved by the PM. [Ref. 70]

2. Preventing Contractor Buy-In

The PM was concerned about contractor efforts to "buy-in" to the PDRR contract. The FAR defines "buying-in" as: [Ref. 71:Part 3.501-1]

> ...submitting an offer below anticipated costs expecting to increase the contract amount after award (e.g., through unnecessary or excessively priced change orders) or to receive follow-on contracts at artificially high prices to recover losses incurred on the buy-in contract.

Preventing contractor buy-in was a real concern because the contractor who won the PDRR contract would be virtually assured of receiving the EMD and Production phase contracts. The PM also knew that the AAAV would consume a significant portion of the Marine Corps' financial resources, and that the Marine Corps did not have the financial resources to absorb the higher costs that could be realized due to early contractor buy-in. [Ref. 72]

To help prevent contractor buy-in, the PM provided GDLS and UDLP a copy of the Government cost estimate of their technical proposal. [Ref. 7] The Government cost estimate showed that both contractors had significantly underestimated their costs and the PM challenged each contractor to prove that the Government's cost estimate was wrong. The PM then gave each contractor the opportunity to modify their Best and Final Offer. [Ref. 7] As a result of the PM's offer, GDLS and UDLP each increased their proposed price by $40M. [Ref. 7] Following a nine-month source selection process, GDLS was awarded the PDRR contract on 13 June 1996. [Ref. 7]

3. Collocation

The down-selection to one contractor for the PDRR phase would allow the collocation of the PM office with the contractor. Although this was an unusual arrangement, the PM felt that it was critical to the success of the program. [Ref. 7]

The PM felt that collocation offered many benefits to both the Government and the contractor. Among these benefits were: reduced program risk; ease of imparting unique Government knowledge and experience with high-speed amphibious vehicles to the contractor; a dramatically reduced decision-making cycle time; increased commitment on the part of employees for program success; and separation from both the Government's and contractor's "flagpole," which would allow acquisition reform initiatives to be more easily implemented. An additional benefit would be the complete indoctrination of Government and contractor employees into the Marine Corps culture and ethos. [Ref. 7] The PM reasoned that once GDLS' employees understood Marines and the environment in which they operated, they would design and build a better vehicle. [Ref. 7]

The PM wanted the contractor to locate their research and development facility "within 20 minutes by car of Springfield, Virginia, the intersection of Interstate 95, 395 and 495." [Ref. 73:p. SOW-4] The PM chose this geographical area for several reasons. First, it was close to Quantico, Virginia - the "Crossroads of the Marine Corps." The Marine Corps Combat Development Center (the combat developer) and the Marine Corps Systems Command (the

Marine Corps' acquisition command) were both located in Quantico. Quantico was also the home of The Basic School, which had a platoon of AAV7A1s, and more importantly, enlisted Marines with amtrac experience. The enlisted Marines would be used as "user juries" during PDRR to evaluate contractor mock-ups and assist the contractor in making design decisions. Second, the location provided easy access to Washington, D.C. The PM knew that frequent meetings and briefings would be required with Congressional staffers, the Department of Defense, and the Department of the Navy. The close proximity to Washington, D.C. also meant that decision-makers could easily conduct site visits and "walk-around" assessments of the program. The contractor was required to have all key personnel (listed in the Key Personnel clause of the contract) located at this facility full time. [Ref. 73:p. SOW-4] Finally, the contractor was required to provide the Program Management Office with office space (including offices, spaces, furniture and equipment) collocated at the contractor's facility. [Ref. 72:p. SOW-135] This is the first time that a MDAP has been completely collocated with the prime contractor and its major subcontractors. [Ref. 74]

The new location would become "neutral ground" for everyone involved on both sides of the AAAV project. [Ref. 7] This move was necessary to help create the "cultural change" that the PM envisioned. [Ref. 7] To achieve this cultural change, the PM wanted the contractor to really understand the user, the Marines that would be operating and maintaining the vehicle. The PM also wanted the contractor to understand the operating environment, vehicle uses, Marine Corps

amphibious doctrine, and various warfighting scenarios. The PM wanted to really influence the people who make the design decisions - the engineers. [Ref. 72] The PM initiated a number of "educational opportunities" for the GDLS employees to know and understand Marines. These opportunities included: [Ref. 72]

a. Spending a night aboard an amphibious ship and living in the troop berthing compartment.

b. Participating in a mock amphibious landing.

c. Driving the AAV7A1.

d. Attending a Sunset Parade at the 8th and I Barracks, Washington, D.C.

e. Participating in Marine Corps leadership training classes.

f. Attending a Marine Corps Mess Night.

g. Hearing first hand the experience of a Marine Corps corporal who almost drowned in an AAV7A1.

All of these events were designed to provide GDLS employees a better understanding for whom they were building the AAAV, the environment in which the system would operate, and the culture within which Marines live.

This cultural change would also be enhanced through collocation and the use of Integrated Product and Process Development (IPPD) and Integrated Product Teams (IPT).

4. Teaming

The PM determined that to make the AAAV program successful, the Government and the contractor would have to adopt a "teaming" approach. [Ref. 7] Teaming would allow the Government and the contractor to forge a close working relationship based on trust and would help eliminate the adversarial relationship that is typical between the Government and the contractor. Collocation would facilitate the use of IPPD and IPT. The PDRR contract required the Government and the contractor to "utilize an Integrated Product and Process Development (IPPD) approach including the concept of 'TEAMING' in managing the program." [Ref. 68:p. H-24] The DODD defines IPPD as: [Ref. 75: Para. D.1(b)]

> ...a management technique that integrates all acquisition activities starting with requirements definition through production, fielding/deployment and operational support in order to optimize the design, manufacturing, business, and supportability processes. At the core of IPPD implementation are Integrated Product Teams (IPTs).

The Statement of Work (SOW) required the contractor to "employ an IPPD systems engineering, management approach and organizational structure as described by the Defense Science Board Task Force Report, 'Engineering in the Manufacturing Process,' of March 1993." [Ref. 73:p. SOW-48] The SOW also required the contractor to "use multi-functional teams (also called Integrated Product Teams (IPTs)) of engineering, production/manufacturing, software,

logistics, Government and other personnel, as appropriate, in its AAAV design efforts." [Ref. 72:p. SOW-48] The DODD defines IPT as: [Ref. 75:Para. E.2(f)]

> ...composed of representatives from all appropriate functional disciplines working together with a Team Leader to build successful and balanced programs, identify and resolve issues, and make sound and timely recommendations to facilitate decision-making. There are three types of IPTs: Overarching IPTs focus on strategic guidance, program assessment, and issue resolution. Working Level IPTs identify and resolve program issues, determine program status, and seek opportunities for acquisition reform. Program IPTs focus on program execution, and may include representatives from both Government, and after contract award, industry.

The SOW required the contractor to at least have an IPT that corresponds to each 2nd level of the vehicle Work Breakdown Structure. [Ref. 73:p. SOW-48]

The IPPD concept would be used to manage the design effort. GDLS is responsible for providing the leadership for each IPT, with the Government members serving as "customer" representatives. The Government representatives would facilitate contractor personnel getting information faster, thereby reducing cycle time. [Ref. 76]

GDLS established the 28 IPTs shown in Appendix F. The 28 IPTs are broken down into four levels, "A" through "D". The level "A" team deals with major program and cost issues. [Ref. 77:p. 31] The level "B" teams are responsible for project management, system integration, test and evaluation, and production design. [Ref. 77:p. 33] The level "C" teams monitor and control discrete performance parameters of the vehicle. [Ref. 77:p. 33] The level "D" teams deal with product issues. Each IPT has representatives from a number of

different disciplines, including engineering, finance, quality assurance, and procurement. [Ref. 78]

Since IPPD and IPT were relatively new concepts to both the Government and GDLS, an outside consulting firm was hired to conduct training for all personnel. [Ref. 79] However, the needed training did not occur until six months after the IPTs were established. The Vice President for GDLS commented that the training needed to start sooner than it did. [Ref. 79] He also remarked that it was difficult learning to work together as a team, and that some of his employees were not suited to act as IPT leaders. These employees were subsequently replaced as IPT leaders. [Ref. 79]

F. SUMMARY

This chapter examined the standard system acquisition process that existed at the time the AAA program began, followed by a discussion on the initiation of the AAV program office, the technology base development program, and the initiation of the AAA program. The chapter then discussed the original acquisition strategy, subsequent revisions to that strategy, and the evolutionary acquisition pursued by the Marine Corps in support of the AAAV program. Next, the chapter described the key events of the Concept Exploration phase. Finally, the chapter concluded with a discussion of key events of the Program Definition and Risk Reduction phase.

The next chapter will analyze the key events of the AAAV program and their impact on the program to date.

IV. AAAV CRITICAL ACQUISITION DECISIONS

A. INTRODUCTION

This chapter will analyze the Advanced Amphibious Assault Vehicle (AAAV) program acquisition events and decisions presented in Chapter III. The focus of the analysis will be on the deviations from the standard system acquisition process and the key events and decisions from the Concept Exploration (CE) phase and the Program Definition and Risk Reduction (PDRR) phase.

B. DEVIATIONS FROM STANDARD SYSTEM ACQUISITION PROCESS

The Marine Corps had been trying to field a replacement amphibious assault vehicle for the LVTP7 since it was first fielded in 1972. The first attempt ended in 1979 with the cancellation of the LVA program and the second attempt ended in 1985 with the cancellation of the LVT (X) program. The two cancelled programs, however, provided the Marine Corps with a number of lessons learned. These lessons learned helped shape the AAAV program and impacted many of the decisions made by the Program Manager (PM). [Ref. 7] OMB Circular A-109 provided the Marine Corps the flexibility to deviate from the standard acquisition process and tailor the AAAV program's acquisition strategy to meet its needs.

Table 3 shows a comparison between when the standard acquisition process model states a certain event normally occurs and when the event

occurred in the AAAV program. The comparison is limited to the Pre-CE phase, the CE phase, and PDRR phase since the AAAV program is currently in the PDRR phase.

Table 3. Standard Acquisition Process Model and AAAV Program Event Comparison

EVENT	STD. ACQ. MODEL	AAAV PROGRAM
Mission Area Analysis conducted	Pre-CE phase	Pre-CE phase
Mission Need Statement developed	Pre-CE phase	Pre-CE phase
Acquisition Strategy developed	CE phase	CE phase
Technology Risk Assessments initiated	CE phase	Pre-CE phase
COEA conducted	CE phase	CE phase
PM appointed	CE phase	CE phase
System Concept Paper prepared	CE phase	CE phase
Operational Requirements Document prepared	CE phase	CE phase
Integrated Program Summary prepared	CE phase	CE phase
Program Life-Cycle Cost Estimate developed	CE phase	CE phase
Risk Reduction efforts initiated	PDRR phase	CE phase
Technical Testing conducted	PDRR phase	PDRR phase
Early Operational Assessment conducted	PDRR phase	CE phase
Best prototype chosen	PDRR phase	CE phase
Support Analyses initiated	PDRR phase	CE phase
System Design Review conducted	PDRR phase	PDRR phase
Low Rate Initial Production components identified	PDRR phase	PDRR phase

Source: Developed by author

As Table 3 depicts, the AAAV program followed the standard acquisition process model with three major deviations. First, they initiated a technology base development program in 1983, which was during the Pre-CE phase for the AAAV program. Second, they initiated a series of risk-reduction projects during the CE phase rather than waiting until the PDRR phase. Third, they conducted two Early Operational Assessments (EOAs) during the CE phase rather than waiting until the PDRR phase. The remaining deviations occurred when the AAAV program chose the best prototype and initiated the Support Analyses process during the CE phase rather than waiting until the PDRR phase.

1. Technical Base Development Program

The technical base development program that began in 1983 gave the Marine Corps a five-year head start on the initiation of the AAAV program, which was formally designated an Acquisition Category (ACAT) ID program in July 1988. The purpose of the technical base development program was to help show that a high water speed amphibian was possible, while at the same time focusing on the high "drivers" of cost, risk and performance. The technology base development program culminated in the Propulsion System Demonstrator (PSD).

The PSD was the key to the technology base development program. The successful demonstration of the PSD would quiet program critics and convince skeptics that a high water speed amphibious vehicle was feasible. The Marine Corps took a significant risk in demonstrating the PSD to numerous influential Department of Defense (DoD) and Department of Navy (DON) personnel on the

Potomac River in February 1992. If the PSD failed to perform as advertised, either on water or on land, the AAAV program could have easily been cancelled. The competition for decreasing DoD procurement dollars was intense and program opponents would have taken advantage of the failure and tried to kill the AAAV program.

The Marine Corps showed a lot of confidence in the AAAV program when it chose to demonstrate the PSD on the Potomac River, which was the most risky option of proving the concept feasibility of a high water speed amphibian. Less risky alternatives the Marine Corps could have used include filming the PSD tests at Patuxent River for later viewing, and establishing a television link to the Patuxent River test site and showing the demonstration real time. The researcher believes that the Marine Corps was making a bold statement to program critics and skeptics by choosing the highly visible live demonstration on the Potomac River. The Marine Corps was so confident about the feasibility of a high water speed amphibious vehicle that it was challenging program skeptics to find fault with the concept. The gamble paid off; the PSD proved that a high water speed amphibious vehicle was possible. Now that the concept was proven, the Marine Corps still had to overcome numerous technical challenges. Many of these challenges were overcome through a series of risk-reduction projects initiated during the CE phase.

2. Risk-Reduction Projects

During the CE phase, a series of risk-reduction project contracts were awarded to GDLS and UDLP to eliminate or mitigate technical risks identified during the two "Red Team" assessments. The decision to initiate the risk-reduction projects during the CE phase can be traced to two overriding concerns of the PM - reducing technical risks prior to the PDRR phase and ensuring the program remained within affordability limits.

The best time to identify solutions to technical problems is early in the concept phase, before the design has matured. As depicted in Figure 1 below, program funds expended during the CE phase represents approximately three percent of total program costs, but the decisions made during this phase commit seventy percent of the total program life-cycle costs.

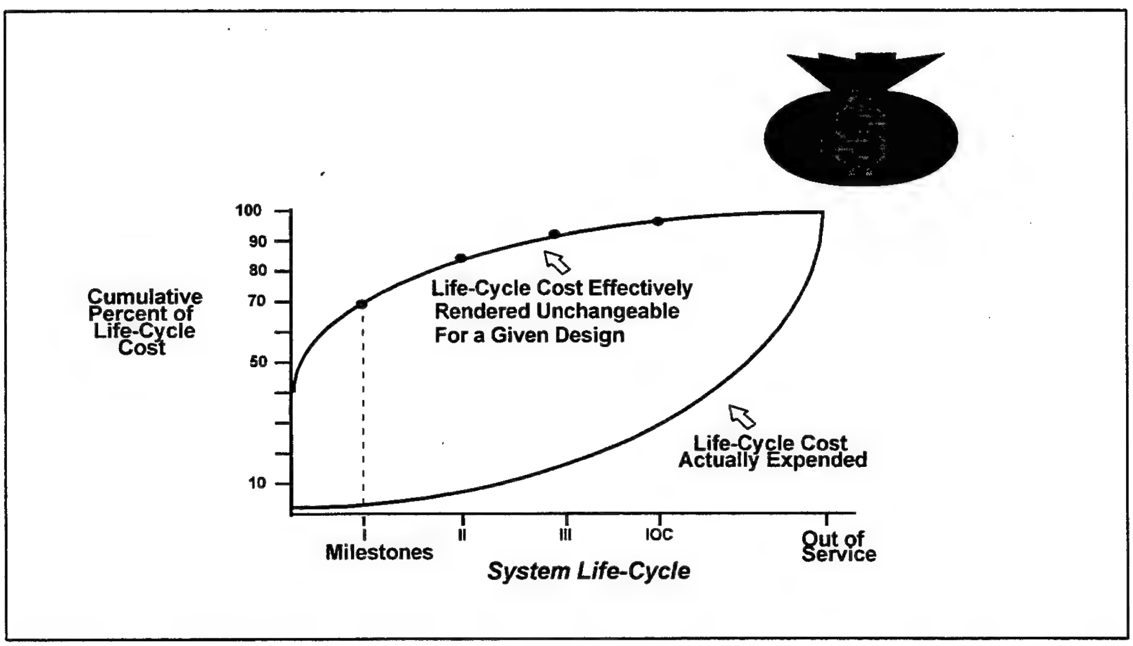


Figure 1. Early Decisions Affect Life-Cycle Cost Source: Ref. [80]

As Figure 1 shows, it is critical that technical risks be identified and mitigated early in the design process to minimize or eliminate the need to make costly design changes later. If the PM had waited until the PDRR phase to identify and mitigate known technical risks, the AAAV program may have become too expensive for the Marine Corps and resulted in program cancellation.

The risk-reduction projects initiated during the CE phase added to the maturity of the AAAV program as it approached its MS I Review. At the time of the MS I Review, there were no areas rated as "High risk" or "Moderate-High risk," a significant achievement for a program as technically complex as the AAAV program. The AAAV program's risk-reduction projects met the Milestone Decision Authority's (MDA's) mandate to reduce technical risk prior to the PDRR phase.

It is the researcher's opinion that the decision to conduct the risk-reduction projects during the CE phase proved to be a key event in the AAAV program for two primary reasons. First, the "Red Team" assessments identified key areas of technical risk associated with each contractor's design, which then led to the risk-reduction contracts subsequently awarded to GDLS and UDLP. These technical risk areas could then be worked on and mitigated while the system design was still immature, thereby avoiding costly design changes later. Second, the risk-reduction projects resulted in the PM adopting an open engine bay architecture policy. Adoption of this policy meant that the system design would not be delayed while work continued on developing an engine that met the stated

horsepower requirement. The open engine bay architecture design requirement placed the burden on the contractor to design a vehicle that could accept any candidate engine without incurring any additional costs to rearrange internal vehicle subsystems and components.

3. Early Operational Assessments

The PM conducted two Early Operational Assessments (EOAs) on both contractors' full-scale, non-functioning vehicle mock-ups during the CE phase rather than waiting until the PDRR phase. The mock-ups contained the physical attributes, design layouts, and Marine-machine interfaces that reflected the contractor's preliminary design. The objective of the early EOAs was to determine how well the preliminary design met operational requirements. The decision to conduct the EOAs earlier than normal once again showed that the PM was concerned about identifying design problems as early as possible.

Marines from the Fleet Marine Force conducted the early EOAs. The Marine participants in the EOAs were AAV crewmen and maintenance personnel, as well as infantrymen who would be passengers in the AAAV. Timed egress trials were conducted to measure dismount and emergency exit times, passenger capacity and stowage space was measured, maintainability characteristics were examined, and human factor deficiencies were identified. After the EOAs were finished, the Marines filled out questionnaires that provided each contractor valuable design feedback from the user's perspective.

The Government and the contractor both benefited from the early EOAs. The Government benefited because it would not have to incur increased costs due to design changes after prototypes were built. An added benefit was that the user had the opportunity to impact the design early enough so the fielded system would better meet his needs. The early EOAs also allowed the user to better assess trade-offs between cost and performance since he could now visualize what the AAAV might look like and how it might be configured. The contractors benefited because the early EOAs allowed them to incorporate design changes now, before they built prototypes in the PDRR phase and discovered their design flaws. The contractors also gained a better understanding of what the user really wanted, particularly those requirements that might not have been clearly spelled out in the Request for Proposal (RFP).

It is the researcher's opinion that the decision to conduct the early EOAs will prove very beneficial as the program matures. As a result of the early EOAs, GDLS was able to make timely design changes before building prototypes in the PDRR phase. The result should be a vehicle better designed to meet the user's needs.

C. PHASE 0 - CONCEPT EXPLORATION

The CE phase for the AAAV program lasted nearly seven years, from July 1988 until March 1995. Normally, this phase lasts two years. [Ref. 81] The Milestone (MS) I Defense Acquisition Board (DAB) Review originally scheduled for May 1991 was postponed several times, partly due to the series of risk

reduction projects that were being conducted from 1991 to 1995. Additionally, the DoD was now requiring all major system new starts to identify technical risk issues and initiate technical risk reduction activities prior to MS I. [Ref. 82] These risk-reduction projects, coupled with the extensive knowledge gained by the Government from the technology base development program and the number of alternatives examined through the Cost and Operational Effectiveness Analysis (COEA) process, resulted in a very mature program by the time MS I was reached. The maturity of the AAAV program was widely recognized throughout the DoD. For example, in response to a question on the AAAV program raised during her Senate confirmation hearing for appointment as the Assistant Secretary of the Navy for Research, Development and Acquisition (ASN (RDA)), the Honorable Nora Slatkin stated:

> ...it seems to be in a more advanced stage of development than most programs in the Concept Phase. This is the bi-product of a decision made several years ago to spend a little longer in the concept phase in order to substantially reduce technical risks prior to its Milestone I Review. [Ref. 83]

The AAAV program's long CE phase was also the result of changes in the national security environment and the DoD systems acquisition process. These changes included: [Ref. 5:p. 1]

1. The dissolution of the Soviet Union and the end of the Cold War meant that there was no longer the pressing need to field new weapons as quickly as before. The emphasis was now on the "front end" of the weapons acquisition

process. As a result, the CE phase became more deliberate and time insensitive.

2. The COEA process came under increased scrutiny and became more comprehensive. Technical feasibility was now being looked at more closely in the CE phase.

3. The MDA became less tolerant of technical risk and wanted these risks reduced prior to entering into the PDRR phase. More technical risk-reducing projects were required during the CE phase to ensure that projected costs were more accurate and would not exceed projected affordability limits.

The Marine Corps also adopted a more deliberate pace during the CE phase to mitigate the technical risks associated with the AAAV program and to ensure that the program remained affordable. [Ref. 61] The Marine Corps was willing to take a little longer in the early phases of the program if it meant technical risks, cost risks, and schedule risks were reduced.

The following sections will analyze the remaining key events and decisions, which were described in the previous chapter, made by the PM during the CE phase.

1. Evolutionary Acquisition Strategy

The Marine Corps adopted an evolutionary acquisition strategy for the AAAV program. This strategy called for focusing on developing the "core" capabilities of the AAAV, and fielding the AAAV as soon as the major core capabilities of water speed, land mobility, firepower, and survivability were

reached. The intent of the strategy was to put the AAAV into the hands of the Marines more quickly while allowing future technical advances to be easily incorporated.

One of the benefits the Marine Corps sought by adopting an evolutionary acquisition strategy was to improve the fielding date for the AAAV. The Marine Corps had hoped to achieve Initial Operational Capability (IOC) in calendar year 2000 and Full Operational Capability (FOC) in calendar year 2004. These dates represented a five-year improvement from the currently projected IOC and FOC dates. This would return the program schedule to its original IOC of Fiscal Year 2000 (FY00). The current AAAV Integrated Schedule, shown in Appendix G, shows IOC being achieved in FY06 and FOC being achieved in FY12. The evolutionary acquisition strategy did not improve IOC or FOC as anticipated because the PDRR phase and Engineering and Manufacturing Development (EMD) phase are longer than originally planned. However, the evolutionary acquisition strategy helps reduce the risk of further schedule slip.

The researcher believes that the evolutionary acquisition strategy will allow the PM to meet the most critical aspect of the evolutionary acquisition strategy, which is to allow future technological advances to be easily incorporated. This capability is achievable because the contractor is required to design in space, weight, power claims, channels, hard points, interface controls; this open systems architecture approach allows new technologies to be easily incorporated. This capability is especially critical if the Marine Corps wants to

take advantage of technological advances in the electronics field, where products can become obsolete in as little as 18 months. Since complete fielding won't be reached until FY12, the Marine Corps does not want to be fielding a vehicle with obsolete technology. The evolutionary acquisition permits system update/modernization as technology becomes available.

2. Program Funding

The AAAV program has only suffered one significant funding cut, Program Decision Memorandum-4 (PDM-4), which was issued in December 1994. PDM-2 was issued in September 1995 and it added back $107M of the $190M cut by PDM-4. It is unusual that any program has the relative funding stability that the AAAV program has enjoyed. On several occasions, Congress increased the funding requested for the AAAV program during the appropriation process.

It is the researcher's opinion that the funding stability can be attributed to several factors. First, the Marine Corps was always open and upfront about all issues and problems concerning the AAAV program. This won them strong Congressional support. Second, the Marine Corps adopted a "One Voice Strategy" for the AAAV program. Once the leadership of the Marine Corps determined that the AAAV was the Marine Corps' number one priority ground weapon system, all Marines threw their full support behind the program. Lastly, the Marine Corps recognized the changing acquisition environment and took a slow, methodical approach to fielding the AAAV. They did not rush the AAAV into production and then worry about the deficiencies later. The procurement of

the AAAV represented a significant financial investment for the Marine Corps and they wanted to make sure it was done right the first time.

3. Personnel Stability

One of the many benefits that the DoD receives from its civilian workforce is the stability that they provide in many DoD offices. The frequent rotation of military personnel necessitates a stable civilian workforce to provide continuity and a solid knowledge base of critical issues and problem areas. It is very difficult for any organization to develop and maintain a cohesive long-term strategy when critical decision-makers are replaced every three to four years.

The AAAV program was unique in that the PM, an active duty Marine Corps officer, was associated with the program from its inception in 1988 until his promotion to Brigadier General and subsequent reassignment in August 1998. The PM was initially assigned as the Assistant Program Manager (APM) for the AAAV program within the AAA program office and was later assigned as the Direct Reporting Program Manager Advanced Amphibious Assault (DRPM AAA) in June 1993. The researcher is not aware of any other instance where a military officer was assigned to a single program for such an extended period of time.

Many of the key civilians within the PM office (PMO) have also been associated with the AAAV program for a number of years. For example, the Deputy PM came to the PMO from the Naval Surface Warfare Center-Carderock Division (NSWC-CD). While at the NSWC-CD, the Deputy PM was involved in the Marine Corps' first effort to develop a high water speed amphibious vehicle,

the Landing Vehicle Assault (LVA), which began in 1972. He also worked on the technology base development program that began in 1983, which eventually proved that a high water speed amphibious vehicle was technically feasible. The PM and Deputy PM handpicked the civilian personnel filling key billets within the PMO.

While it is not possible to quantify how the PM's long assignment to the program has benefited the program and the Marine Corps, the researcher has concluded that they both have benefited. This conclusion was reached based on numerous interviews the researcher conducted with people involved with the AAAV program over the past ten years. All of the people interviewed indicated that the PM's first hand knowledge of critical issues and problem areas allowed the program to maintain a coherent long-term strategy, mitigate technical risks early in the program, focus on reducing program life-cycle costs, and initiate the acquisition reform efforts necessary to break away from the existing inefficient and cumbersome acquisition system. The researcher does not believe the AAAV program would have attained its high level of system maturity in the CE phase if the PM had rotated every three or four years as is typical in a program office.

D. PHASE I - PROGRAM DEFINITION AND RISK REDUCTION

The PDRR phase began in June 1996 when a sole source contract was awarded to GDLS. It is scheduled to last nearly five years, with the MS II Review scheduled for January 2001. The PDRR phase normally lasts two to four years. [Ref. 81]

Throughout the CE phase, the PM considered how to take advantage of the acquisition reform initiatives being discussed within the DoD. The following sections will analyze the key events and decisions, which were described in the previous chapter, made by the PM in preparation for the PDRR phase.

1. Down-Selection To One Contractor

The PM decided during the CE phase to down-select to only one prime contractor for the PDRR phase rather than waiting until the EMD phase as is normally done. The PM based his decision on the fact that the Government possessed a unique knowledge base of the AAAV, the maturity of the AAAV program due to the risk-reduction projects previously discussed, and because the competing contractor's designs were not significantly different. The PM's decision was also based on financial concerns. The PM estimated that he would save $190M by having only one contractor during the PDRR phase vice two contractors. [Ref. 61] Besides saving money, it would be easier for the Government to impart its extensive knowledge of AAAV-related issues to a single contractor rather than spending time ensuring that both prime contractors received the same information.

The decision to have only one prime contractor during the PDRR phase carried some risks. These risks included no competitive pressure on the winning contractor to reduce costs, possible gold-plating, and the attempt by each contractor to "buy-in". With only one prime contractor in the PDRR phase, competition for future prime contracts was reduced. The prime contractor who

won the PDRR contract was virtually assured of winning the prime contract for the remaining program phases. The PM needed a way to maintain competition and incentivize the winning contractor to continue to pursue design improvements and recommend design changes beneficial to the Government.

The PM mitigated the risk of having only one prime contractor in the PDRR phase through three specific actions. First, the PM used a Cost-Plus-Award-Fee (CPAF) contract for the PDRR phase. Second, the PDRR contract included the AAAV Special Design Decision provision. Third, the PM mandated that the contractor maintain competition at the component and subassembly levels. The CPAF contract and the AAAV Special Design Decision provision will be discussed in the following sections.

The PM viewed the prime contractor as a system level designer and a subsystem integrator, and therefore, could maintain an adequate level of competition during the PDRR phase by mandating competition at the component and subassembly levels. The PM placed the responsibility on the prime contractor to continue subsystem and component trade-off analyses to maximize total system performance while minimizing system life-cycle costs. This shift in responsibility from the Government to the contractor was in keeping with the acquisition reform efforts underway within the DoD in the mid-1990s. The Government wanted contractors to assume more risk and responsibility in designing and producing more cost-effective weapon systems.

It is the researcher's opinion that the benefits from down-selecting to one prime contractor for the PDRR phase outweighed the risks. The Government benefits because it saved $190M in program costs by having only one contractor during the PDRR phase. The contractor benefits because he has sole access to all of the Government's knowledge on amphibious vehicles, and is virtually assured of receiving the EMD and production contracts for the AAAV. Thus, a long-term partnering relationship between the Government and the contractor was established very early in the program, a relationship that could last more than 16 years. Furthermore, the researcher believes that the potential risks from having only one contractor in the PDRR phase were adequately mitigated through the three specific actions previously discussed.

2. Cost-Plus-Award-Fee Contract

The original acquisition strategy stated that a Cost-Plus-Fixed-Fee (CPFF) contract would be awarded for the PDRR phase. A CPFF contract is the most common type of contract used in the research and developmental phases of an acquisition program. As the AAAV program acquisition strategy continued to evolve, the PM chose to use a Cost-Plus-Award-Fee (CPAF) contract in the PDRR phase instead of a CPFF contract.

The principal drawback to using a CPFF contract is that there is little incentive for the contractor to control his costs. The contractor is reimbursed for all allowable costs and earns a fixed fee regardless of the quality of his work. It is also very difficult for the PM to influence the contractor's focus or to penalize

him for the poor quality of his work when a CPFF contract is used. By using a CPAF contract, the PM had the means to incentivize the contractor to control his costs and also force him to focus on the specific areas that the PM deemed most important. This capability was crucial because with only one contractor in the PDRR phase, the PM could not count on competitive pressures to influence the contractor's actions.

The CPAF contract provided the PM with the means to force GDLS to focus its efforts on specific areas during the award period. Each award period covers approximately six months. The CPAF contract provides the PM the flexibility to adjust GDLS' developmental efforts as the PM's priorities change. At the beginning of each award fee period, the PM provides GDLS with the areas he wants emphasized during that fee period. Every month, the PM and his staff provide GDLS representatives with an interim evaluation of their performance on the stated goals for that period. At the end of the award fee period, the Award Fee Review Board meets and recommends to the PM an award fee. The PM is the Award Fee Determining Official. His decision is final and is not subject to protest.

The researcher believes that the PM's choice of a CPAF contract for the PDRR phase was the correct choice given that there would only be one contractor during this phase and the PM wanted the ability to influence his efforts. The other cost-reimbursement type contracts would not have given the PM the same influence over the contractor. Additionally, the researcher believes

that the monthly interim evaluation is critical to ensuring that GDLS understands the PM's intent and focus for that period. If there is a misunderstanding or the PM does not feel that GDLS is making satisfactory progress, GDLS still has time to make the necessary adjustments. Since the AAAV program is operating in a teaming environment, it is crucial that open lines of communication be maintained between the PMO and GDLS.

3. AAAV System Design Decision Provision

The inclusion of the AAAV System Design Decision provision in the PDRR contract is another example of the PM's concern over influencing the vehicle's design as early as possible. Recognizing the adverse impact that making design changes late in the program has on total life-cycle costs, the PM wanted to incentivize the contractor to conduct realistic trade studies and propose design changes as early as possible. The AAAV System Design Decision provision provided the incentive the PM sought.

The AAAV System Design Decision provision states:

> ...situations may occur in which...trade-off analyses clearly indicate the desirability of design decisions which would significantly increase the Contractor's costs of performance during the Demonstration/Validation (Dem/Val) Phase because of substantially greater long-term benefits to the AAAV Program resulting from anticipated savings in subsequent Program Phases and/or lower life cycle costs throughout the service life of the AAAV. [Ref. 68:p. H-31]

> ...if the Government determines that the overall, long-term benefits to the Marine Corps substantially outweigh the additional costs to be incurred by the Contractor during Dem/Val Phase, the Contract will be equitably adjusted to reflect the Contractor's anticipated increase in Dem/Val costs (including FCCM and fee) resulting from the design decision. [Ref. 68:p. H-32]

If this provision had not been included in the contract, GDLS would not have had any real incentive in the PDRR phase to reduce program life-cycle costs through realistic trade studies. Without this provision, GDLS would have been reimbursed for all allowable costs incurred for the design change, but they would not receive any additional Facilities Capital Cost of Money (FCCM) or fee. The additional FCCM and fee provided GDLS a financial incentive to aggressively pursue cost-reducing trade studies. Additionally, the AAAV System Design Decision provision did not penalize GDLS in the cost portion of the Earned Value Management System. Their budgeted costs would be adjusted to reflect the authorized increase in instant contract costs resulting from the design change, thereby preventing the increased costs as being viewed as a cost overrun.

The AAAV System Design Decision provision is unique in that it attempts to achieve the benefits obtained from a Value Engineering Change Proposal (VECP) during the PDRR phase rather than waiting until the product enters production. Like the AAAV System Design Decision provision, the objective of a VECP is to reduce the program's projected life-cycle cost through a change in the project's plans, designs, or specifications as defined in the contract. However,

VECPs are not used until the item enters production. The PM wanted to achieve life-cycle cost savings earlier in the program.

The researcher believes that the inclusion of the AAAV System Design Decision provision has been effective. This conclusion is based on the three trade studies discussed in the previous chapter. The three trade studies increased the Government's costs during the PDRR phase by $5.9M but will result in a projected life-cycle cost savings of over $316M.

4. Preventing Contractor Buy-In

The PM was very concerned about preventing contractor buy-in for the PDRR phase and then having to face significant cost growth later in the program. His concerns seem to be justified when, after providing each contractor the Government's cost estimate for their proposal, each contractor increased their proposed price by $40M.

It is the researcher's opinion that the PM made the right decision to show the contractors the Government's cost estimate for their respective proposal. The PM's Bill of Rights and Responsibilities states that the PM has the responsibility to "prepare thorough estimates of financial and personnel resources that will be required to manage the program." [Ref. 84] As the Marine Corps' number one priority ground weapon system, it would have been easy for the PM to ignore the contractor's attempt to buy-in to the program. The PM could have allowed the winning contractor to buy-in and then worried about finding the additional funding later. Fortunately for the Marine Corps, the PM adhered to his

responsibilities and forced each contractor to submit a more realistic proposal. The AAAV program had earned a reputation within the DoD and Congress as being upfront and honest about program issues. On numerous occasions Congress showed its support for the AAAV program by increasing program funding. The PM was determined not to violate this trust by knowingly accepting a low offer, which could place the program in financial jeopardy (making it too expensive) and cause additional Office of the Secretary of Defense (OSD) and Congressional scrutiny.

5. Collocation

The Request for Proposal (RFP) for the PDRR phase contained the requirement for the contractor to locate his research and development facility in a very specific geographic area in the Northern Virginia area between Washington, D.C. and Quantico, Virginia. The reason why this particular geographical area was chosen was discussed in the previous chapter. The RFP also required the contractor to provide facilities (offices, work space, furniture, and equipment) for the Government employees assigned to support the AAAV program.

This requirement was unusual for a Major Defense Acquisition Program (MDAP) and in fact, this is the first time that a MDAP has been physically collocated with the prime contractor and major subcontractors. After being awarded the PDRR contract, GDLS purchased a research and development facility in Woodbridge, Virginia. This facility was opened in August 1996.

The requirement to locate its research and development facility in the Northern Virginia area resulted in personnel staffing problems for GDLS early in the PDRR phase, causing them to fall behind in their work. GDLS found considerable resistance when they asked their employees to move from the Detroit metropolitan area to Northern Virginia. Many of the handpicked employees that GDLS wanted at its new facility did not want to leave the Detroit area. Some of the reasons given included not wanting to uproot families; anxiety of moving to a new area; and a perceived lack of upward mobility within the corporation if they moved so far away from the flagpole. GDLS was asking its employees to move away from an environment they understood and where they felt comfortable to an unfamiliar environment in a new state. GDLS had tried to overcome these concerns by using financial incentives as the principal means to entice employees to move to the new location. Only 40 employees relocated to Northern Virginia and GDLS had to recruit more employees than they had anticipated.

Collocation also caused a new relationship to be established between Government and contractor employees. The adverse relationship that oftentimes existed between the two groups had to be eliminated if collocation was to be successful. Government and contractor employees had to learn to work together and trust each other. The barriers to an open work environment, such as the "Us versus Them" mentality and the incomplete sharing of information, had to be overcome. A more open line of communication had to be established and the

cultural environment both sides were used to working in had to change if collocation was to succeed. While this new relationship was being fostered, the rules governing undue familiarity and undue influence had to be observed and maintained. This was particularly critical because the PDRR phase contract was a CPAF contract and the Government had to ensure that the award fee determination process was not tainted.

Based on the interviews conducted and documents reviewed, it is the researcher's opinion that collocation has been very successful. The PM stated that the AAAV program probably would have failed without collocation. [Ref. 7] Collocation provided the PM with the means to indoctrinate contractor and Government civilian personnel into the Marine Corps ethos and culture and implement the acquisition reform initiatives he sought. The PM's counterpart at GDLS, whose title is Vice President for General Dynamics Amphibious Systems (GDAMS) (a subsidiary of GDLS formed for the AAAV program), was equally enthusiastic about how well collocation was working, and he faced a more difficult challenge than the PM. GDLS is closely watching the collocation effort and is using it as a model for other programs. PMO and contractor employees agree that collocation has dramatically reduced decision-making time, improved communication flow, reduced the number of internal program reviews, and allowed concurrent Government approval of documents prepared by Integrated Product Teams (IPTs). [Ref. 85:p. 5]

6. Teaming

Collocation of Government and contractor personnel facilitated the use of Integrated Product and Process Development (IPPD) and Integrated Product Teams (IPTs) in the AAAV program. The requirement to establish a new facility in Woodbridge, Virginia gave the Vice President for GDAMS, who was the onsite manager for GDLS, the opportunity to handpick his employees. He recognized that collocation and the requirement to utilize IPPD and IPTs would provide him with some unique challenges. The IPPD and IPT environment was new to both Government and contractor employees and a considerable amount of training was necessary to prepare everyone for this new environment. He also had to find people who could successfully operate in this new environment, especially since GDLS employees would lead each IPT, except for Government-only coordination IPTs.

One of the cornerstones to the DoD acquisition reform effort initiated in the mid-1990s was the move to operate in IPTs rather than the functional stovepipe organization normally found in DoD programs. The Secretary of Defense, Dr. William Perry, mandated the use of IPPD and IPTs in a memorandum published in 1995. DoDD 5000.1 established the following six principles for operating in an IPT: [Ref. 75:p. 7]

a. Open discussions with no secrets

b. Qualified, empowered team members

c. Consistent, success oriented, proactive participation

d. Continuous 'up the line' communication

e. Reasoned disagreement

f. Issues raised and resolved early

Operating in an IPT environment is not easy. There is a cultural change that personnel must undergo before teaming can be effective. A high degree of trust between team members must also be developed before the benefits from teaming are realized. This cultural change must implemented through a comprehensive training program. For the AAAV program, GDLS hired an outside consultant to conduct the training because they lacked the requisite expertise.

It is also critical that the right personnel be chosen to work in a teaming environment. Managers may find that some of their key personnel are not suited to work in an IPT environment and even though an individual may be a valuable employee, he (or she) should not be assigned to an IPT. GDLS found that they had to replace several IPT leaders because they were not suited for working in teams. One of the key characteristics of a successful IPT is cooperation. Team members must put aside their personal likes and dislikes and work together as a team. The team must remain focused on a common goal and strive to reach it together. Otherwise, the team will fail.

Managers should not underestimate how difficult it is to implement teaming. Besides overcoming cultural differences and individual personalities, it will take time to develop the group dynamics necessary to attain the benefits

from teaming. The PM gave the following personal traits that he looked for before hiring Government employees for the AAAV program: [Ref. 72]

a. Self-discipline

b. Maturity

c. Speaking and listening skills

d. Self-worth/self-respect

e. Possessing self-confidence with humility

f. Ability to adapt (flexibility)

g. Ethical and good sense of morals

Teaming is now a part of the DoD acquisition process, and Government and contractor managers and employees must learn to operate in this new environment. Implementing IPPD and IPT is not as easy as it might sound. It takes time to train personnel and change the culture in which they are used to operating. The benefits of teaming are numerous, but they will not happen overnight. The AAAV program began teaming over two years ago and there is still room for improvement.

The PM thought that the IPTs were working well in some areas and needed some work in others. He felt that the middle level management (B and C level) IPTs were not as productive as he would like and he thought the working level (D level) IPTs were well integrated and productive. The VP for GDAMS felt that the IPTs were working well but improvements were still required.

It is the researcher's opinion that mandating an IPPD and IPT environment has greatly benefited the AAAV program. Two examples of how IPTs were used to combat vehicle weight growth illustrate their benefit. First, each "D" level IPT was given a "Not to Exceed" weight that could not be breached without compensation from another IPT or identification of additional weight reduction initiatives. This forced the IPTs to consider how their decision impacted vehicle weight and also prevented uncontrolled vehicle weight growth. Second, the contractor's IPT members were incentivized to further reduce vehicle weight and unit production cost by being awarded $50 for every pound in savings and/or $250 reduction in unit production cost. The result was a 1500-pound weight reduction and a $100,000 saving in unit production cost. Government IPT members were not eligible for the award. The researcher believes that teaming will continue to help the AAAV program field a vehicle that meets all of the user's needs.

E. SUMMARY

This chapter analyzed what effect deviations from the standard acquisition process have had on the AAAV program, and the key events and decisions made during the CE phase and the PDRR phase. The researcher determined that all of the decisions analyzed during this chapter have proven to be forward-thinking and insightful. These decisions have allowed the AAAV program to reduce technical risk, save money, and maintain strong Congressional support. The requirement to collocate with the contractor and use

teaming has proven to be successful and validates the acquisition reform initiatives introduced in 1994. The researcher also concluded that personnel stability has played a key role in the program's success.

The final chapter presents the researcher's conclusions, recommendations and answers the primary and subsidiary research questions.

V. CONCLUSIONS AND RECOMMENDATIONS

A. INTRODUCTION

The objective of this research effort was to examine the critical program management decisions made during the early phases of the Advanced Amphibious Assault Vehicle (AAAV) program. The goal was to determine what impact those decisions had on the AAAV program at that time, the future implications of those decisions, and if those decisions could benefit other Major Defense Acquisition Programs (MDAPs).

The research effort began with a discussion of the standard acquisition life-cycle process that existed at the time the AAAV program was initiated, followed by an examination of the key events and decisions that occurred during the Concept Exploration (CE) phase and the Program Definition and Risk Reduction (PDRR) phase. This chapter will then discuss the conclusions drawn by the researcher after the key events and decisions were analyzed in the previous chapter. The researcher will then provide specific recommendations for the Department of Defense (DoD) for use in other MDAPs. Finally, the researcher will answer the primary and subsidiary research questions and provide some recommendations for further study.

B. CONCLUSIONS

1. The technology base development program and risk-reduction projects resulted in a very mature AAAV program early in the program's acquisition life-cycle.

The technology base development program placed the Government in the position of having more knowledge about high water speed vehicle technology than industry. As a result, it was the Government, not industry that proved the concept of a high water speed amphibious vehicle was feasible. Additionally, this knowledge allowed the Government to initiate risk-reduction projects earlier in the program and to assess the contractor's progress in mitigating those risks. The risk-reduction projects eliminated all high risk and moderate-high risk areas prior to the Milestone I Review. Although the risk-reduction projects were partly responsible for the long CE phase, they resulted in a very mature program with manageable technical risks. As added benefit, the technology base development program and the risk-reduction projects allowed the Government to down-select to only one contractor for the PDRR phase, thereby saving an estimated $190M.

2. The evolutionary acquisition strategy will result in an amphibious assault vehicle that will meet future Marine Corps requirements.

The evolutionary acquisition strategy allows the Marine Corps to field a weapon system now that meets the core capabilities while allowing future technological advances to be easily incorporated later. The requirement for the contractor to design in weight, space, power claims, channels, hard points, etc.,

will permit the Marine Corps to modernize the AAAV throughout its expected 30 year life-cycle. As the threat changes, the open systems architecture allows new technologies to be incorporated into the AAAV to maintain its battlefield superiority without having to make extensive, and costly, modifications to the existing vehicle configuration.

3. <u>The Program Manager's (PM's) long assignment to the AAAV program greatly benefited the program by interjecting stability in an often turbulent business.</u>

The PM worked on the AAAV program for ten years and had personal knowledge of all critical program issues, which allowed these issues to be quickly addressed. Also, because the PM had been with the program for so long, the program office spoke with one voice. This is very important when dealing with Office of the Secretary of Defense personnel and members of Congress. A program office must avoid sending out mixed signals and contradictory program information. A single, coherent acquisition strategy that is fully understood by all employees will eliminate this problem and the result will be a better managed program. The acquisition strategy is best developed by a PM who not only fully understands the intricacies of the program, but who also knows that he will be responsible for executing the strategy for many years to come.

4. <u>The collocation of Government and contractor employees has proven to be very successful in improving communications among Government and contractor participants.</u>

Key Government and contractor personnel stated that collocation has been a real benefit to the AAAV program. Collocation has allowed the teaming environment to be adopted more quickly because team members see each other on a daily basis. Communication between Government and contractor employees has improved greatly because rather than having to depend on phone calls and periodic visits, face-to-face meetings can occur whenever needed. The cultural change envisioned by the PM was enhanced because of collocation and, most importantly, the contractor's employees now have a better understanding of who the user is and what he wants because collocation affords them daily interaction with Marines. Collocation improved the Government and contractor employees' ability to build the trust and mutual respect that is critically important in a teaming environment. It also helped eliminate the adversarial relationship that typically exists between the Government and the contractor.

5. Integrated Product and Process Development (IPPD) and Integrated Product Teams (IPTs) have resulted in improved communications, increased awareness of program issues, and reduced the decision-making cycle-time.

The primary objective of IPPD is to satisfy the customer's needs better, faster, and at less cost. Using IPPD and IPTs has resulted in problems being raised and solved earlier. Problem areas are openly discussed and IPT members work together to solve the problem. Since Government employees worked with contractor employees to solve the problem, the Government design review process is shortened and a decision can be quickly rendered. IPTs can

identify needed design changes earlier in the design process, when the change can have the most impact on reducing total life-cycle costs.

6. Many of the PM's decisions were based on his desire to impact the vehicle's design as early as possible.

The PM clearly understood the relationship between design and total ownership cost (TOC). He knew that the later a needed design change was initiated, the less impact it would have on reducing TOC. Therefore, the PM wanted to identify design flaws and conduct realistic trade studies as early in the program as possible. He accomplished this by initiating risk-reduction projects and conducting Early Operational Assessments during the CE phase. To influence the design during the PDRR phase, the PM included the AAAV System Design Decision provision, chose to use a Cost-Plus-Award-Fee (CPAF) contract, mandated collocation, and required the use of IPPD and IPTs. All of these decisions allowed the PM to influence the vehicle's design early in the AAAV's acquisition life-cycle.

7. The Cost-Plus-Award-Fee (CPAF) contract and the AAAV System Design Decision provision have been effective in incentivizing the contractor.

The CPAF contract has allowed the PM to exert additional influence over the contractor's actions during the PDRR phase. If the contractor wants to earn the full award fee for that period, he must meet all of the Government's requirements. It is particularly important for the PM to be able to influence the contractor's actions during the PDRR phase because there is only one prime

contractor. The AAAV System Design Decision provision provides the contractor an added financial incentive to conduct realistic trade studies and make design decisions that are in the best interest of the Government.

C. RECOMMENDATIONS FOR DOD

1. A Program Manager should be assigned to a program office for longer than four years.

The PM's ten-year association with the AAAV program proved to be very beneficial to both the Marine Corps and the program office. His first hand knowledge of critical program issues allowed him to develop and execute a long-term program strategy. A program's strategic vision cannot be developed and implemented if a new PM is assigned every four years, particularly if the new PM has no previous experience with the program. If the DoD wants to adopt the best commercial practices, then acquisition workforce personnel should be assigned to a MDAP for a significant portion of their career. Future PM's should be mentored and groomed within a program office. They should fill a variety of increasingly more demanding billets within the program office to gain experience and develop a more comprehensive understanding of program issues. Admittedly, this would be difficult to implement but it accurately reflects how many corporations grow their future top level managers.

2. Other technically complex programs should adopt the evolutionary acquisition strategy.

The rapid pace of technological advances makes many components of new weapon systems obsolete by the time their systems are fielded. To overcome this problem, an evolutionary acquisition strategy promoting an open system architecture should be adopted. Users should identify the core capabilities for a new system and once they have been met, the user must be willing to accept the system as is and wait for the remaining capabilities to be incorporated when the technology has matured. Adopting this strategy should result in the faster fielding of new weapon systems, reduced component obsolescence, and lower modernization costs.

3. Program offices should be collocated with their prime contractors when practicable.

Collocation was successfully implemented in the AAAV program and proved to be very beneficial to Government and contractor employees. If the DoD wants to receive the full benefit from operating in a teaming environment, then it should work closely with the defense industry and adopt collocation as a new way of doing business.

4. Program offices should use the IPPD concept and IPTs where practicable, and include training as an essential ingredient.

The IPPD concept and IPTs have proven to be very successful in the AAAV program. However, both Government and contractor employees state that the proper training of IPT members is essential to the successful implementation of the IPT process. The DoD should develop a comprehensive IPT training

program for all acquisition personnel so Government employees are better prepared to work in a teaming environment.

D. ANSWERS TO RESEARCH QUESTIONS

The preceding chapters provided the background and analysis of the critical program management decisions made during the early phases of the AAAV program. This section will answer the primary and subsidiary research questions posed in Chapter I. The subsidiary questions will be answered first since they provide the basis for answering the primary research question.

Subsidiary Question #1. What was the original Advanced Amphibious Assault (AAA) concept and how did it lead to the establishment of the AAAV program?

The AAA concept evolved from a doctrinal change that required the Marine Corps to have the capability of launching an assault from Navy ships stationed 20 to 25 miles from the shore. The Marine Corps' existing amphibious assault vehicle was not capable of conducting surface assaults from that range. The Cost and Operational Effectiveness Analysis (COEA) looked at 13 alternatives for accomplishing the ship-to-objective movement of Marines. Eight of the 13 alternatives examined during the COEA were not amphibious vehicles. The COEA determined that a high water speed amphibious vehicle, the AAAV, was the most effective alternative.

Subsidiary Question #2. What was the Marine Corps' initial acquisition strategy for the AAAV program and how has it evolved?

The initial acquisition strategy was developed in 1988 after the AAA program successfully passed its Milestone (MS) 0 Review. This acquisition strategy called for up to three Firm-Fixed-Price (FFP) contracts being awarded for the CE phase, two Cost-Plus-Fixed-Fee (CPFF) contracts being awarded for the PDRR phase, and fielding 1400 AAAVs with an Initial Operational Capability (IOC) of 4th quarter, Fiscal Year 1999 (FY99). Two FFP contracts were awarded for the CE phase. During the CE phase, a number of technical risks were identified that required the PM to award three sets of risk-reduction contracts to the two competing contractors. Reducing technical risk and ensuring program affordability became the PM's major focus during the CE phase. The PM down-selected to one contractor and chose to use a Cost-Plus-Award-Fee (CPAF) contract for the PDRR phase rather than a CPFF contract. The current acquisition strategy shows that 1013 AAAVs will be fielded with an IOC of 3rd quarter FY06.

Subsidiary Question #3. <u>What was the organizational structure used to execute the acquisition strategy of the AAAV program?</u>

The AAAV program's organizational structure is unique within the DoD. The PM mandated that the Government employees supporting the program would be physically collocated with the prime contractor's key employees. Collocation facilitated the use of teaming in the program, which was another PM requirement. The PM also mandated that the Government and the prime contractor use an Integrated Product and Process Development (IPPD) and

Integrated Product Team (IPT) approach to manage the program. The contractor established 28 IPTs to help manage the AAAV's program, with the contractor providing the leadership for each IPT.

Subsidiary Question #4. <u>What have been the critical acquisition decisions of the Program Management Office and how have they impacted the AAAV program?</u>

The PM made several critical decisions early in the AAAV program that refined the program's acquisition strategy. These critical decisions were:

a. To initiate risk-reduction projects during the CE phase, which resulted in a technically complex amphibious vehicle having no risk area rated higher than moderate at the MS I Review.

b. To conduct two Early Operational Assessments during the CE phase, which provided the user the opportunity to evaluate each contractor's preliminary vehicle design very early in the design phase. The contractor used this information to make design changes now, before building prototypes, rather than having to make changes after the design has matured.

c. To adopt an evolutionary acquisition strategy, which will allow the contractor to focus on developing the core capabilities of the AAAV. The remaining capabilities will be incorporated later when the technology is available. Since the AAAV will not enter production until FY06, this strategy will allow the Marine Corps to field a vehicle with the most technologically advanced systems

available rather than delaying system fielding awaiting technology maturation beyond the core requirements.

d. To down-select to one contractor for the PDRR phase, which allowed the Government to impart all of its knowledge on amphibious vehicles to just one contractor and save an estimated $190M in the PDRR phase. Down-selecting to one contractor also allowed the PM to achieve collocation and facilitated the use of IPPD and IPTs.

e. To use a CPAF contract during the PDRR phase, which incentivizes the contractor to control costs and also provides the PM with the means to focus the contractor's developmental efforts on specific areas throughout the PDRR phase.

f. To include the AAAV Special Design Decision provision in the PDRR contract, which gives the contractor an added financial incentive to conduct realistic trade studies. Three completed trade studies increased the Government's contract costs during the PDRR phase by $5.9M but will result in a projected total life-cycle cost savings of over $316M.

g. To prevent contractor "buy-in" by showing each contractor the Government's cost estimate on their proposal for the PDRR phase, which resulted in each contractor increasing their proposed price by $40M. Preventing contractor "buy-in" gave the Marine Corps a more realistic cost estimate for the PDRR phase.

h. To mandate the physical collocation of Government and key contractor employees, which allowed the PM to achieve the cultural change he wanted and to implement the acquisition reform initiatives he sought. Collocation has dramatically reduced decision-making time, improved communication flow, reduced the number of internal program reviews, and allowed concurrent Government approval of documents prepared by IPTs.

i. To require the use of IPPD and IPTs, which will be addressed in the following subsidiary question.

Subsidiary Question #5. <u>What impacts have Integrated Product and Process Development and Integrated Product Teams (IPTs) had on the PMO and the AAAV acquisition effort?</u>

IPPD and IPTs have had a positive effect on the AAAV program. IPT members are more aware of program issues and problem areas can be quickly addressed. The IPT environment results in quicker resolution to problems because Government and contractor employees work together to solve the problem. By empowering Government employees to make decisions, the decision-making cycle time for the Government review of the proposed solution is shortened.

Subsidiary Question #6. <u>How might an analysis of program management decisions made in the early phases of the AAAV program be used in the successful execution of other defense acquisition program?</u>

The program management decisions made in the early phases of the AAAV program will benefit other defense acquisition programs because many of the decisions cited represent the successful implementation of several DoD acquisition reform initiatives. The AAAV program adopted the IPPD concept, empowered employees through IPTs, sought relief from low value added directives, focused on total life-cycle costs instead of initial acquisition cost, and used unique contract clauses to incentive the contractor. The AAAV program also mandated collocation during the PDRR phase, which has proven to be very successful. PMs for other defense acquisition programs should carefully examine these decisions and determine how they can be tailored to meet their program needs.

Primary Research Question. What have been the critical program management decisions and events regarding the Advanced Amphibious Assault Vehicle (AAAV) program, how have these affected the nature and scope of the AAAV program as it exists today, and how will an analysis of these critical decisions and events affect the development, production, and deployment of the AAAV?

The critical AAAV program decisions, which were discussed in the answers to the subsidiary questions, resulted from three primary PM concerns. The PM wanted to reduce technical risk, ensure program affordability, and influence vehicle design. Many of these decisions addressed more than one of his concerns. The PM reduced technical risk through the initiation of the risk-

reduction projects. He ensured program affordability by conducting two EOAs during the CE phase, down-selecting to one contractor for the PDRR phase, inserting the AAAV Special Design Decision provision in the PDRR contract, and preventing contractor "buy-in" by showing each contractor the Government's cost estimate of their proposal. The PM influenced vehicle design by conducting the two EOAs earlier than normal, adopting an evolutionary acquisition strategy, down-selecting to one contractor for the PDRR phase, using a CPAF contract for the PDRR phase, inserting the AAAV Special Design Decision provision in the PDRR contract, mandating collocation, adopting the IPPD concept, and implementing IPTs.

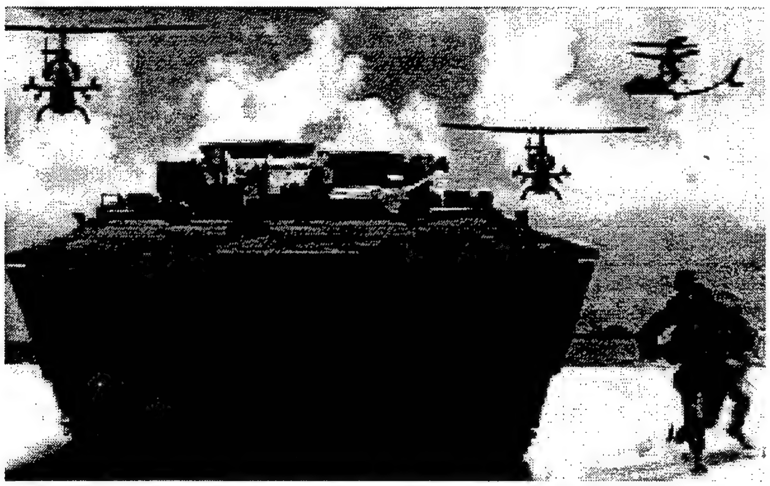
The PM created a new environment where Government and contractor employees had to learn to trust one another and work together for a common goal - to provide the Marine in the field with the best advanced amphibious assault vehicle possible within budget constraints. This new environment appears to be working. Significant life-cycle cost savings have been identified through the unique design decision provision and IPTs, and the program is on schedule to begin testing the first AAAV prototype later this year.

E. AREAS FOR FURTHER RESEARCH

As a result of this research effort, the researcher has identified three areas for further research. First, the IPT process is still relatively new and it is not as easy to implement as some might expect. One of the most significant barriers to

its successful implementation is training. A study that identifies the training requirements for Government employees prior to an assignment to an IPT would facilitate the adoption of the IPT process and allow the benefits from IPTs to be realized sooner. Second, the physical collocation of Government and contractor employees has greatly benefited the AAAV program. Collocation creates a new working environment that can cause ethical and contractual problems. An analysis could be conducted to determine what impact collocation would have on current Standards of Conduct, ethics, and contracting regulations. Third, the AAAV program used modeling and simulation and established a Virtual Design Database to assist the contractor in designing the vehicle. An analysis of the impact that they have had on the AAAV program would be beneficial to other defense acquisition programs.

APPENDIX A: A CASE STUDY OF THE U.S. MARINE CORPS ADVANCED AMPHIBIOUS ASSAULT VEHICLE (AAAV) PROGRAM



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MILESTONE I DECISION

Colonel James M. Feigley smiled as he hung up the phone. The phone call was to the Commandant of the Marine Corps (CMC) to inform him that his program had passed its Defense Acquisition Board (DAB) Milestone (MS) I Review. The Marine Corps could now go forward with building the new Advanced Amphibious Assault Vehicle (AAAV), for which Col. Feigley was the Program Manager (PM). But Col. Feigley was no ordinary PM; he was a Direct Reporting Program Manager (DRPM) with a unique reporting chain that left him unencumbered by much of the bureaucracy that faced many of his fellow PMs. At the same time, he was more on his own than the others, which made the good news even better. A sense of satisfaction came over Col. Feigley as he reflected back on the long road the Marine Corps had traveled to field a replacement vehicle for its aging Assault Amphibian Vehicle (AAV) – the AAV7A1. See Attachment 1 for a timeline of the AAAV program.

AMPHIBIOUS DOCTRINE

Although the Marine Corps has always maintained a maritime orientation, it expended little effort toward developing amphibious assault doctrine before the British disaster at Gallipoli in 1915. The disaster at Gallipoli and the Navy's involvement in War Plan ORANGE, a contingency plan developed in 1915 for war with the Japanese in the Pacific, provided some visionary Navy and Marine Corps officers the opportunity to focus on amphibious assault operations and develop the necessary doctrine. One such visionary Marine officer was Major Earl H. Ellis.

Major Ellis predicted that if war broke out with Japan, the United States would have to battle its way across the Pacific to defeat the Japanese. After extensive research, Major Ellis wrote a study in 1920-21 entitled "Advanced Base Operations in Micronesia." Uncanny in its eventual accuracy, Major Ellis outlined in detail how he saw the United States western drive across the Pacific to defeat the Japanese occurring. He predicted the need to establish advanced support bases in the Marshall and Caroline Islands to meet the needs of the naval fleet. So thorough was his study, it was adopted by the Joint Board of the Army and Navy and called the "Orange Plan." [1]

The leadership of the Marine Corps recognized the significance of Major Ellis' study. In preparation for executing the "Orange Plan," the Marine Corps held numerous training exercises throughout the 1920's designed to develop the skills necessary to conduct amphibious operations. Many worthwhile lessons learned were obtained from these early exercises, which later assisted in the initial development of amphibious doctrine. Training and equipment deficiencies were also identified during the exercises. The training deficiencies could be corrected quickly by developing amphibious doctrine. The need for specialized

landing crafts was seen as a critical equipment deficiency, a deficiency that would take over a decade to resolve.

HISTORY OF AMPHIBIOUS ASSAULT VEHICLES

The Marine Corps is tasked by section 5013(b) Title 10 of the United States Code to "develop.... those phases of amphibious operations that pertain to the tactics, techniques and equipment used by landing forces." An amphibious operation is an attack launched from the sea by naval and landing forces, embarked in ships or craft involving a landing on a hostile or potentially hostile shore. An amphibious assault is the principal type of amphibious operation, with the remaining types being the amphibious raid, demonstration, and withdrawal. Conducting amphibious operations is nothing new to the Marine Corps. On March 3, 1776, a short four months after the Marine Corps was established, Marines conducted their first amphibious operation - an amphibious raid on New Providence, Bahamas. This would be the first of countless successful amphibious operations conducted by the Marine Corps in its illustrious history. The Marine Corps' last major amphibious operation was the amphibious assault at Inchon, Korea in 1951 that turned the tide in the Korean War.

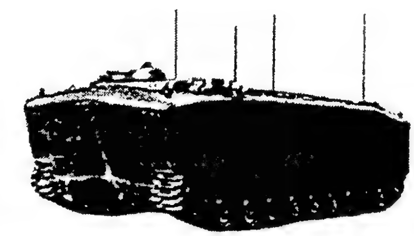
As doctrine was being developed in the 1920's and 1930's, the Marine Corps turned its focus on procuring the equipment necessary to conduct an amphibious assault. Although the Marine Corps had been conducting amphibious operations since its founding, it did not possess an amphibious assault vehicle until August 1941. This vehicle, known as the Landing Vehicle, Tracked Model 1 (LVT-1) Amphibian Tractor, could achieve 7 miles per hour on the water and 18 miles per hour on the land, and had a cargo carrying capacity of 4000 pounds.[2] The LVT-1, commonly referred to as an amtrac, saw plenty of action during World War II. Serving primarily as a logistics vehicle transporting supplies from Navy ships to supply dumps ashore during the early years of the war, a new role for the LVT was discovered during the landing at Tarawa in November 1943. For the first time, LVTs were used to transport Marines on the initial assault. Although nearly half of the LVTs were disabled by enemy fire during the assault, the LVT proved to be effective in transporting the assault force.[3] The LVT now had a second mission - serving as an armored personnel carrier during the amphibious assault. However, the amtrac was not formally designated an assault amphibian until 1977, 34 years after the Tarawa landing.

LVT1
1941

Significant improvements and modifications were made to the LVT-1 during World War II. One significant improvement was the addition of a stern ramp. Stern ramps eased cargo handling, permitted the landing of small vehicles and weapons, and allowed assault forces to storm the beach straight from the

LVT without having to climb over the vehicle's sides. By the end of the war, four cargo variants and two assault gun variants had been produced. All together, 18,816 LVTs were produced during World War II.[4]

In 1953, the Marine Corps fielded the LVTP-5 as the replacement for the LVT(3)C. This was the first new version of the LVT since World War II. The LVTP-5 provided increased performance and more importantly, included several variants. These variants consisted of recovery, command, engineer support, and fire support (105mm howitzer mounted in the turret) vehicles.[5] The LVTP-5 saw considerable action during both the Korean War and the Vietnam War, where it participated in most of the 62 landings made by Marines. During the Vietnam War, the amtracs showed their versatility once again by also serving as armored personnel carriers, logistics vehicles moving supplies across inland waterways, patrol vehicles both ashore and afloat, and even serving in an infantry role near the Demilitarized Zone.[6]



LVTP5
1952

COLONEL JAMES M. FEIGLEY, USMC

Col. Feigley was no stranger to either amtracs or acquisition. Following his commission in 1972, he became an infantry officer and was assigned to an Amtrac Battalion where he served as a platoon commander. Following an assignment at one of the Marine Corps Recruit Depots and the Amphibious Warfare School, then Capt. Feigley returned to an Amtrac Battalion in 2nd Marine Division where he served as a Company Commander and Battalion Operations Officer. Following this assignment, Capt. Feigley served as a Company Commander in a Tracked Vehicle Battalion in 3rd Marine Division. Then came his first acquisition related assignment. After being promoted to Major in 1982, he was assigned to the Naval Training Equipment Center, Orlando, Florida, where he became the Project Manager for Marine Corps ground training and simulation equipment. During this assignment, he attended the Project Managers Development Course at the Army Logistics Management College, Ft. Lee, Virginia. (See Attachment 2 for Colonel Feigley's biography)

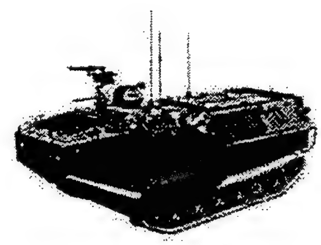
Major Feigley graduated from the Marine Corps Command and Staff College in 1986 and was assigned to another acquisition-related job as a Project Officer in the Marine Corps Deputy Chief of Staff for Installations and Logistics Weapons Branch. Following reorganization of Marine Corps development and procurement activities, he was assigned to the newly formed Marine Corps Research, Development, and Acquisition Command (MCRDAC), Washington, D.C., as a Project Officer in the Armored Combat Vehicle Directorate. During this tour of duty he attended the Program Management Course at the Defense Systems Management College (DSMC), Ft. Belvoir, Virginia. After this tour, he

was assigned to the Naval Sea Systems Command (PMS-310) as the Advanced Projects Officer for PMAAV)

1. What education/experiences are necessary to make a Program Manager successful?
2. Had Major Feigley received enough training to assume Project Officer positions?

THE LVTP-7

Second Lieutenant Feigley's commission in the Marine Corps in 1972 coincided with the delivery of the Corps' latest version of the amtrac, the LVTP-7. The LVTP-7, shown here, carried 25 combat loaded Marines, and had a speed of 8.4 mph in the water. Due to its slow water speed and poor waterborne characteristics while swimming, the ride to the beach was demanding. The resulting decrease in the combat effectiveness of the embarked Marines led to most ship-to-shore movements for an amphibious assault beginning only 4,000 yards from the beach. Fortunately, enemy direct fire offensive weapons expected to be encountered during an opposed amphibious landing did not seriously threaten the amphibious task force even at extended ranges.


LVTP7
1971

In some ways the LVTP-7 offered fewer capabilities than its predecessor, the LVTP-5. The differences are shown in Figure 1.

COMPARISON HIGHLIGHTS		
Characteristic	**LVTP-5**	**LVTP-7**
Speed		
Overland	30 mph	40 mph
Water	6.8 mph	8.4 mph
Operating Range		
Overland	190 miles	300 miles
Water	57 miles	70 miles
Surfing Capability	15 ft.	10 ft.
Water Turning Diameter	140 ft.	Pivot
Water Payload	12,000 lbs.	10,000 lbs.
Troop Capacity	34	25
Combat Equipped Weight	70,500 lbs.	40,249 lbs.
Overall Length	29'8"	26'
Armament	M1919A4 .30 cal	M85 .50 cal
Fuel	Gasoline	Diesel
Operating Cost	$72/hr	$40/hr
Unit Cost	$146,000	$129,550

Figure 1

(Chart from Marine Corps Gazette, June 1972, pg. 32)

Even though the newer amtrac had a greater range, was cheaper to operate, and cost less per vehicle, it carried fewer Marines, had a smaller payload, and only offered a slight improvement over its predecessor's waterborne speed. It was the slow water speed that worried most Marines, as advances in weapons technology were making the future for amphibious assaults increasingly more deadly to ships as well as assault craft.

The Marine Corps realized that it took time to develop and field a new weapon system. The planned ten-year service life of the LVTP-7 meant the Marine Corps must immediately begin developing its replacement, and they wanted a replacement that would revolutionize amphibious doctrine by offering a high-water speed. This was the dream of many Marines who were aware that some limited technology had been demonstrated in the late 1960's that showed the potential for a high-water speed amphibian.

3. *What drove the Marine Corps to buy the LVTP-7?*
4. *What advantages and disadvantages did the LVTP-7 offer over the LVTP-5?*
5. *When should you start planning for replacing a major weapon system?*
6. *What are some of the considerations that effect the amount of time it takes to develop and field a new major weapon system?*

THE LVA PROGRAM

The Marine Corps initiated a feasibility study in 1971 to develop a replacement for the LVTP-7. In 1973 a Tentative Operational Requirement was established that identified the need for a high-speed (70 mph on water/55 mph on land) amphibious vehicle with an Initial Operational Capability (IOC) of 1986. This program became known as the Landing Vehicle Assault (LVA) program. After feasibility studies were conducted, Conceptual Design contracts were awarded in 1976 to FMC Corporation, Bell Aerospace Textron, and Pacific Car and Foundry.

In 1978, the Department of Defense (DoD) approved the Marine Corps' Amphibious Warfare Surface Assault (AWSA) Mission Element Needs Statement (MENS) for the LVA. As directed by the Under Secretary of Defense for Research and Engineering, the Marine Corps conducted a Cost and Operational Effectiveness Analysis (COEA) on four alternatives identified in the AWSA MENS. They were the LVA (high- water speed amphibian), the Landing Vehicle, Tracked (Experimental) (LVT (X)) (low- water speed amphibian), an Infantry Fighting Vehicle (IFV) (brought ashore on high-speed landing craft), and an all helicopter-borne assault force. After reviewing the results of the Conceptual Design studies for the LVA in 1979, the Commandant of the Marine Corps (CMC) cancelled the LVA program, citing concerns about vulnerability, affordability, and maintainability. (See Attachment 3)

Although the LVA program had been cancelled, the knowledge gained by the Marine Corps and the Naval Surface Warfare Center - Carderock Division (NSWC-CD) (formerly known as the David Taylor Naval Research and Development Center) from the early experiments with developing a high-speed water amphibious vehicle was not lost. NSWC-CD, a Navy research laboratory located in Bethesda, MD, began working on the LVA program in 1974. As a result of the LVA program, the Marine Corps had established a close working relationship with the NSWC-CD. In 1985, when the Marine Corp decided to once again look for a high-speed amphibious vehicle, it turned to the NSWC-CD for help.

7. What were the underlying causes that led to the cancellation of the LVA program?
8. Discuss the impact of potential doctrinal changes on the LVA program.

UPGRADES TO THE LVTP-7/AAV7

The cancellation of the LVA program in 1979 caused the Marine Corps to develop a Service Life Extension Program (SLEP) and a Product Improvement Program (PIP) for the LVTP-7, which was now being referred to as the AAV7 in recognition of its mission change as an assault amphibian. Since no replacement vehicle was ready for the AAV7, a SLEP was begun in 1982 to

extend the AAV7 service life to 1994. A PIP was initiated in 1985 to improve the combat viability of the AAV7 to the year 2004. The PIP included an automatic fire suppression system, a bow plane, an armor upgrade, and an Upgunned Weapon Station (featuring a 40mm Mk19 Mod 3 machinegun, an M2HB .50-caliber machinegun, and an M257 smoke grenade launcher). In conjunction with the SLEP, the AAV7 was redesignated the AAV7A1. The SLEP cost nearly $1 billion and the PIP cost over $140 million.

LVT(X) PROGRAM: "YESTERDAY'S TECHNOLOGY FOR TOMORROW'S PRICES"

The LVT(X) was identified in 1978 as one of four alternatives to the AWSA MENS. The LVT(X) was a low-water speed, and therefore viewed as a low risk amphibious vehicle. The original IOC for the LVT(X) was 1986, but by 1983 it had slipped to 1997. The turning point in the LVT(X) program occurred during the 1984 Marine Corps System Acquisition Review Council Milestone I review. During the review, critical questions concerning the validity of the LVT(X) requirements were raised. These questions were adequately answered and the CMC gave approval for the LVT(X) program to proceed into the next phase, Program Definition and Risk Reduction (PDRR) (known then as the Concept Demonstration and Validation phase). However, questions about the validity of the LVT(X) requirements continued over the next year and resulted in the CMC recommending to the Secretary of the Navy (SECNAV) that the LVT (X) program be cancelled. The SECNAV determined that the marginal improvements in firepower and armor in the LVT (X) compared with the LVTP7A1 were not worth the estimated $9 billion cost of the new program and the program was cancelled in 1985. More importantly, the AAAV program was now designated as the new replacement vehicle for the AAV7A1. The new program was not scheduled to begin until Fiscal Year (FY) 1991, which forced the Marine Corps to once again extend the service life of the AAV7A1. Subsequent to the cancellation of the LVT(X) program, a Required Operational Capability (ROC) for the AAV7A1 PIP was approved.

The cancellation of the LVT(X) program meant the Marine Corps lacked a credible future amphibious assault vehicle that could replace the existing AAV and offer substantial improvement in performance across the board. This deficiency caused some people to question the Marine Corps' existing amphibious doctrine, claiming that the "traditional concepts of an amphibious assault (were) obsolete" because of the "vulnerability of ships and slow moving landing craft to modern weapons systems."[7] If the Marine Corps needed to maintain the nation's ability to conduct amphibious forceable entry operations, it had to find an advanced method of moving Marines from ship-to-objective and around the battlefield.

9. In six years, the Marine Corps had cancelled two different programs developed to replace the LVTP-7. What appears to be the underlying cause for the high technical risk of the LVA and the high cost of the LVT(X)?

DOCTRINAL CHANGES IN AMPHIBIOUS WARFARE

The Iranian hostage crisis in 1979 revealed significant weaknesses in the United States' ability to handle small-scale expeditionary contingencies. As a result, the Carter Doctrine was developed in January of 1980 as a way to resolve the problems in the Arabian Gulf region. This was the first step on the path that led to the revalidation of a global military strategy for United States. The Department of the Navy's (DoN) response to the changing world environment was to publish "The Maritime Strategy" in 1983. "The Maritime Strategy" addressed the role of Naval Forces in the execution of the National Military Strategy.[8]

In June of 1985, the CNO and the CMC published the "Amphibious Warfare Strategy" (AWS) as a subset to "The Maritime Strategy". Recognizing the lethality that modern weapons would have on ships forced in close to shore to debark slow-moving assault landing craft, the AWS stated that amphibious forces could be stationed over-the-horizon (OTH) at sea.[9] This new strategy identified two new and then unfielded pieces of equipment, the Landing Craft, Air Cushion (LCAC) and the MV-22 tilt-rotor aircraft, as part of the new equipment that would be used to conduct these OTH operations. The LCAC and MV-22 were crucial because their high speed and long range provided the capability to operate from over the horizon while still allowing for a much more rapid closure to the objective.[10] Surprisingly, there was no mention in this new strategy of the AAV, an improved AAV, or the AAAV.

During the mid-1980's the Marine Corps clearly recognized that its aging equipment did not support the new OTH concept. The AAV was too slow and had limited firepower and survivability. The CH-46 Sea Knight helicopter had been fielded in the 1960's and was reaching the end of its service life. Responding to these deficiencies, the Marine Corps began a modernization program that allowed Marine Air-Ground Task Force's (MAGTFs) to become more lethal and mobile while still maintaining their amphibious character.[11] The MV-22 was being developed as a replacement for the CH-46 while the AAV underwent a SLEP to extend its service life. At this same time, fielding of the LCAC had begun and was revolutionizing ship-to-shore movement. The evolving amphibious concept caused the Marine Corps to once again look for a high-speed amphibious assault system, as the LCAC was a cargo carrier never designed for "first wave" employment.

10. Was the relationship between doctrinal changes and requirements generation 'proper'?

ESTABLISHMENT OF THE AAV PROGRAM OFFICE

Following the retirement of the Marine Corps colonel managing the LVT(X) project, the program was managed by committee at the Naval Sea Systems Command (NAVSEA). The committee consisted of the Acquisition Coordinating Group (consisting of project officers from four different Marine Corps activities) and the Principal Development Activity (PDA) (NAVSEA). The Marine Corps wanted to take a more active role in managing the program so in 1984 the Marine Corps Assault Amphibious Vehicle Program Office was established as office PMS-310 within NAVSEA. A billet for a Project Manager for Marine Corps Assault Amphibious Vehicles (PMAAV) within PMS-310 was also established. PMS-310 was responsible for maintaining the AAV and, for the first time, establishing and coordinating technological development efforts in support of advanced amphibious vehicles. The acquisition relationships for the PMS-310 office are contained in Attachment 4.

The SECNAV was the Milestone Decision Authority (MDA) for the AAA program. The Commander, Naval Sea System Command (COMNAVSEA) was assigned Head Contracting Agency (HCA), Source Selection Authority, and NAVSEA Program Executive Officer (PEO) responsibilities. The Commanding General, Marine Corps Development and Education Center (CG, MCDEC) was responsible for specific technical base projects. Effectively, the PMAAV had a number of bosses – from NAVSEA to the Director, Development Center at MCDEC.

The above relationship changed slightly in July 1988 when the Deputy Secretary of Defense signed the Milestone 0 Program Decision Memorandum (PDM) approving the AAA program as a potential new Acquisition Category ID (ACAT ID) major system start. The Under Secretary of Defense for Acquisition (USD(A)) became the new MDA.

11. What are some of the problems associated with a lack of "unity of command" in initiating a new program?
12. What is the significance of passing Milestone 0?

TECHNOLOGY BASE DEVELOPMENT PROGRAM

When PMS-310 was established in 1984, one of its tasks was to manage the technological development effort in support of the next generation of amphibious assault vehicles. Numerous efforts had been undertaken before Milestone 0 approval to reduce the risk and cost of a high water speed amphibious assault vehicle. In 1985, the Amphibious Warfare Technology Directorate (AWT) at MCRDAC initiated a technology base development program. The Marine Corps Program Office at NSWC-CD executed the research and development effort. NSWC-CD had worked on the very limited high water speed technology proposed for the LVA program, was familiar with naval

architecture technology, and had an understanding of what the overall technical requirements were to design a high speed amphibian. Based on this knowledge, NSWC-CD had developed a vision of what a AAAV might look like and the characteristics it must possess. From this vision, NSWC-CD systematically developed key technical subsystems and integrated them in a series of advanced technology demonstrators.

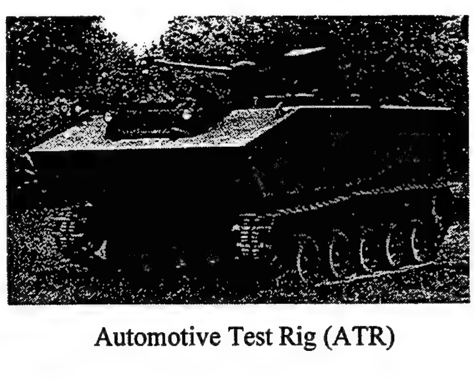
The technology base development program was intended to help show that a high water speed amphibian was feasible, while at the same time targeting the high "drivers" of cost, risk and performance. The specific approach taken to develop the technology base was to develop each subsystem in a competitive environment and then systematically integrate groups of technologies in successively more complex test beds. These subsystems included tracks, armor, suspension, drive train, hull and frame, engines, water jets, and hydrodynamic systems. The culmination of the technology base development program was the integration of all subsystems into an "all-up" advanced technology transition demonstrator – and then test the demonstrator before deciding upon an amphibious vehicle concept. It would also serve to validate amphibious vehicle alternatives in the Cost and Operational Effectiveness Analysis (COEA). The results of the technology base development program, successes and failures, were made available to industry via the Defense Technology Information Center. There were three key projects in the technology base development program.

13. Given that Milestone I wasn't scheduled until 1991, what were the benefits of the Technology Base Development program that began in 1985?
14. What were the funding implications of the Technology Base Development program?

1. Automotive Test Rig

The Automotive Test Rig (ATR) was the first step in the Marine Corps' quest to prove that a high water speed amphibian was feasible. Using the knowledge they gained during the LVA program, NSWC-CD began projects that reduced the vehicle weight; developed a retractable hydropneumatic suspension; and developed the first "drive-by-wire" system for a combat vehicle.

A Cost-Plus-Fixed-Fee (CPFF) contract was competitively awarded to AAI Corporation to produce the ATR. The ATR was a .50 scale, 14 ton, manned vehicle that was used



Automotive Test Rig (ATR)

to prove the feasibility of the land automotive components needed by the AAAV before they were included in the next phase of the technology base development program.[12]

15. What other contract type(s) would be appropriate for this type of program?
16. What are the advantages of using a CPFF contract in this type of program?
17. What are the risks associated with "scaled" demonstrators?

2. High Water Speed Technology Demonstrator

The AAI Corporation was competitively awarded a follow-on contract by NSWC-CD to produce the High Water Speed Technology Demonstrator (HWSTD) in 1987-88. Again, a CPFF contract was used for this phase of the technology base development program. The HWSTD was the next logical step up from the ATR. Weighing in at 16 tons, the HWSTD was .60 scale and incorporated many of the land components and subsystems of the ATR with fully amphibious features such as a bowflap, track covers and a transom flap with integrated water jets. The HWSTD was tested extensively from December 1989 through the first quarter of 1990 at the Surface Effects Ship Support Office (SESSO) at Patuxent River, Maryland. During testing, the HWSTD achieved water speeds of 33 miles per hour.

18. What other contract type(s) would be appropriate for this type of program?
19. What are the advantages of using a CPFF contract is this type of program?
20. How was this effort attacking the previous program's problems of excessive technical and cost risk?

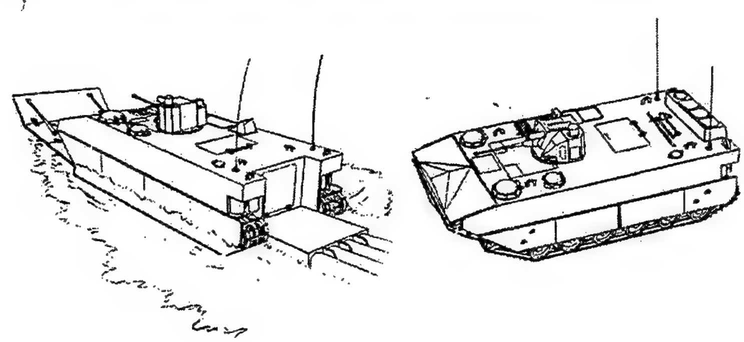
3. Propulsion System Demonstrator

The Propulsion System Demonstrator (PSD), a .90 scale, 30 ton armored amphibious vehicle, was the final step in the technology base development program. The contract for the PSD was a competitively awarded CPFF contract that went to the AAI Corporation. The objective of the PSD was to demonstrate the feasibility of attaining 20 plus mph over water in a full scale troop carrying vehicle. While the ATR and the HWSTD demonstrated land automotive and waterborne capabilities, they were not armored and they were not capable of carrying personnel, other than the driver and a test engineer. The PSD, on the other hand, was armored and could carry a crew of three along with sixteen infantry. The PSD was a <u>demonstrator</u> vehicle, not a AAAV prototype.

The PSD, tested at SESSO on the Patuxent River in the Fall of 1991 through March 1992, achieved a top water speed of 28.7 knots. A demonstration of the PSD was also held on 12 February 1992 on the Potomac River, near the Washington Monument. Attending this demonstration were a number of DAB principles and staff members from the Under Secretary of

Defense for Acquisition's office as well as the Department of the Navy. Attendees included the Head of the Conventional Systems Committee (USD(A)), Mr. Kendall; the Director of Land Warfare (USD(A)), Mr. Viilu; the Director of Naval Warfare (USD(A)), Mr. Martin; the ASN(RDA), Mr. Cann; the CMC, General Mundy; and several members from the Office of the Secretary of Defense's Program Analysis and Evaluation office and the Cost Analysis Improvement Group. During two demonstrations held that day, the PSD successfully demonstrated its maneuverability and high-water speed capability. The PSD then demonstrated its ability to reconfigure itself from a sea-mode to a land-mode vehicle and drove up the ramp at the Bolling Air Force Base yacht basin to provide the observers a first-hand look at the PSD. These successful demonstrations helped prove that the concept of a high-water speed amphibious assault vehicle was indeed feasible.

PROPULSION SYSTEM DEMONSTRATOR



21. What risks did the PM and the Marine Corps take by conducting the PSD demonstrations in front of these key acquisition officials?
22. What may have happened to the program if the PSD had failed, malfunctioned, etc.?
23. What are some of the benefits of technology demonstrators versus paper studies?

PROGRAM INITIATION

In December 1987 a Mission Area Analysis (MAA) was completed on ship-to-shore movement that identified significant operational deficiencies with the existing AAV7A1. These deficiencies were identified by the Marine Corps in a Mission Need Statement (MNS) titled "Advanced Amphibious Assault" for a replacement to the AAV7A1 as part of its 1988 Program Objective Memorandum (POM) submission for FY90 and FY91. After receiving approval by the Conventional Systems Committee, the DAB, and the Defense Resources Board, the Deputy Secretary of Defense signed the PDM on 14 July 1988 approving the Advanced Amphibious Assault (AAA) as a potential new ACAT ID major system program. The Acquisition Decision Memorandum (ADM) was signed by the USD(A) on 19 August 1988. This signified the beginning of Phase 0 (Concept Exploration phase) of the AAA program.

The MNS submitted by the Marine Corps offered three examples of potential alternatives to the existing AAV7A1. The three alternatives were a new high water speed amphibian, a new low water speed amphibian ferried ashore by a high-speed craft or sled, or an improved AAV7A1 (dubbed AAV7A2) ferried ashore by a high-speed craft or sled. After reviewing these alternatives, the DAB modified the MNS and tasked the Marine Corps in the ADM to develop a wider range of alternatives.

MAJOR FEIGLEY JOINS PMS-310

During his assignment as a Project Officer in the Marine Corps' Deputy Chief of Staff for Installations and Logistics Weapons Branch, the Marine Corps reorganized its development and procurement activities. Previously, these activities were spread out among several Marine Corps organizations. To streamline the acquisition process, the Marine Corps established the Marine Corps Research, Development and Acquisition Command (MCRDAC). Soon thereafter, Major Feigley was transferred to MCRDAC as a amphibious vehicle Project Officer in the Armored Combat Vehicle Directorate. Major Feigley was transferred in 1988 to PMS-310 after managing the Milestone 0 effort and initiation of the AAA program. He was subsequently assigned to the PMAAV office for duty as the Assistant Program Manager. Major Feigley's singular focus was the AAA program, while the PM focused on the AAV program. In August of 1989, Major Feigley was promoted to the rank of Lieutenant Colonel.

CONCEPT EXPLORATION PHASE

The AAAV program entered the Concept Exploration (CE) phase upon publication of the Milestone 0 Program Decision Memorandum in July 1988. The Acquisition Decision Memorandum, published the following month, directed the Marine Corps to "examine alternatives of placing infantry ashore, not just a new amphibious vehicle." The program was officially named Advanced Amphibious Assault (AAA) to reflect the expanded scope of its pursuit for a solution to the ship-to-objective portion of the OTH doctrinal concept.

The general purpose of the CE phase is to identify a specific system concept or concepts for development in later phases. Typically during this phase a number of study contracts are awarded to private industry for the exploration of possible alternatives to meet the stated mission need. A multitude of activities are completed and documentation and analysis prepared for the MS I decision. The requirements activity was to prepare the COEA, which compares possible alternative solutions on the basis of cost and operational effectiveness, and documents the rationale for rating one alternative to another. Cost estimating is one of the key activities of this phase. The PM must develop a Program Life-Cycle Cost Estimate (PLCCE) for all alternatives and obtain both an Independent Cost Estimate (ICE) from an activity not in the acquisition chain and an

affordability certification from the Service headquarters staff. All these estimates will be used to judge the viability of the proposed program and to provide preliminary cost inputs to the POM. The user also prepares the Operational Requirements Document (ORD), which documents more specific operational needs necessary to eliminate the broad warfighting deficiencies described in the MNS.

The high water speed approach was determined to be technically feasible as a result of the progress being made in the technology base development program. However, it was realized that there were other system approaches that could be utilized to possibility satisfy the necessary operational requirements.

The CE phase of the AAAV program can be divided into two parts. The first part defined the problem and explored different alternatives while the second part exploited the knowledge gained during the technology base development and applied it to the COEAs' preferred alternative, thus reducing technical and cost risk prior to actual program initiation at Milestone I (MS I).

1. Part One

The problem tackled during this part of the CE phase was centered on the system mission. The first set of contracts was awarded to FMC and General Dynamics Land Systems (GDLS) in February and April 1990 respectively. These first contracts were Firm-Fixed-Price (FFP) and were awarded for $1.5 million each. The contracts were awarded by the NAVSEA contracting officer supporting PMS-310.

The purpose of the first set of contracts was to gain industry input into the different technical approaches and cost uncertainties. Under these first study contracts, FMS and GDLS were tasked with: developing concept designs, cost estimates, development plans, tow tank test models of their proposed design; providing armor samples; and building a full-scale mock-up.

The requirement to award a cost-type contract did not apply to these contracts for two reasons. First, they were less than $10 million each. Second, a fair and reasonable price was established by the Government based on historical cost data for this type of study.

As the Concept Exploration phase progressed, the first COEA was completed in March 1991. The COEA evaluated 13 different alternatives that included high-water speed amphibians, low water speed amphibians, non-amphibians (e.g. armored personnel carriers, infantry fighting vehicles) and non-vehicles (e.g., all air via helicopter or all surface via LCAC). The results of the COEA clearly showed that the AAAV was the overall superior choice by a considerable margin. Additionally, the AAAV was found not to be the most expensive alternative as many had expected. See Attachment 5 for additional details on the CE phase COEAs.

2. Part Two

In the Spring of 1991, the DRPM AAA felt that the program was prepared for the upcoming Milestone I (MS I) DAB Review, which was scheduled for 29 May 1991. In preparation, the MS I Review process began on 11 April 1991 with the Marine Corps Program Decision Meeting (MCPDM). At this meeting, the ASN(RDA) expressed his concerns about the plan to use two competing contractors to each build and test different prototypes during the upcoming Program Definition and Risk Reduction (PDRR, formerly known as the Concept Demonstration and Validation) phase. As had been planned, the AAAV Program Management Office would select the best features of each prototype and use those features to produce a new specification. The new specification would be the AAAV design used during the following Engineering and Manufacturing Development (EMD) phase of the program. The ASN(RDA) was also concerned about the maturity of engine development. The result of the MCPDM was that ASN(RDA) requested that the program conduct an independent technical assessment prior to moving further through the MS I DAB Review process. The assessment would evaluate the perceived technical risks associated with the new AAAV. As a result of these issues, as well as some others, it was decided that the program was not ready to proceed to the MS I DAB Review and a postponement was necessary. The MS I DAB Review was finally held in March 1995.

Program affordability also became an issue in 1994. In November 1991, the CMC directed the DRPM AAA to investigate lower cost development and production strategies. Two new alternatives/strategies, known as AAAV(M) and AAAV(V), were developed in December 1991/January 1992 and the COEA was expanded in February 1992 to evaluate these new alternatives. The two alternatives were similar in that they both contained a mix of high-speed and low-speed amphibious vehicles. Over the next year, the second COEA carefully analyzed the AAAV(M) and the AAAV(V). At first, both alternative strategies had some limited merit but in the end, the second COEA determined that the AAAV, as originally had been planned, was still the most operationally and cost effective alternative.

24. What were the risks of requesting cancellation of the May 1991 DAB?
25. What risks do program instability pose (contractor, cost, schedule, entire concept)?

1. First "Red Team" Assessment

After the MCPDM, the ASN(RDA) tasked the Office of Naval Research's (ONR) Office of Advanced Technology (OAT) to conduct an independent "Red Team" assessment of FMC's and GDLS's AAAV designs and the AAAV program. The Red Team assessment, completed in July 1991, identified three chief areas

of technical risk regarding the two contractor's designs and made seven recommendations for mitigating or eliminating the risk.

Following the "Red Team" assessment, the DRPM AAA awarded FMC and GDLS follow-on contracts that focused on conducting technical risk-reducing experiments. The follow-on CPFF contracts were awarded in September 1991. Since these contracts were not competitively awarded, a class Justification and Approval (J&A) was approved by ASN(RDA). The MCRDAC Contracting Officer supporting DRPM AAA awarded these contracts. These contracts included the fabrication and testing of near-full scale hydrodynamic test rigs of the contractor's own design and numerous other activities focused on all areas of technical risk.

2. Second "Red Team" Assessment

In 1992, ONR conducted a second "Red Team" technical assessment, which was completed in November 1992. This assessment evaluated the contractor's new AAAV design and the results of their technical risk-reducing activities. The assessment included the following findings and recommendations:

> - The risk-reducing initiatives and action taken by the AAAV Program Office since the ONR July 1991 technical assessment have resulted in the elimination of high risk areas in both the FMC and GDLS baseline concepts for the AAAV.
>
> - Initiate full-scale prototype design, development and testing.

The final set of CE contracts was awarded to GDLS and FMC in July 1993. These non-competitive follow-on contracts were CPFF contracts awarded by MCRDAC. The purpose of the contracts was to have both contractors continue their risk-reducing efforts. See Attachment 6 for the Executive Summary of the two ONR Red Team reports.

26. What are the potential results of delays in the program while "Red Team" assessments are being conducted? Benefits?
27. What is the impact of the "Red Team" assessments on the PMO, the contractor, and DoD?

ESTABLISHMENT OF THE DRPM AAA PROGRAM OFFICE

The program management resources within the DON associated with Marine Corps Assault Amphibians were consolidated into a single program office in March 1993. The ASN(RDA), the designated Chartering Authority for the AAA program, signed a Charter 1990 establishing the Direct Reporting Program Manager Advanced Assault Amphibian (DRPM AAA) Program Office. The resources from PMS-310 were consolidated with resources from the MCRDAC

(CBAV office), and the PMAAV was redesignated as DRPM AAA. Designation as a DRPM eliminated the multiple reporting chains faced by the PMAAV. The DRPM now reported directly to ASN(RDA), who serves as the Naval Acquisition Executive (NAE), on all matters of cost, schedule, and performance of assigned programs. All current and future Marine Corps AAV programs (including advanced development, production, modernization, conversion and life-cycle technical support) now fell under the cognizance of the DRPM AAA. The MCRDAC was to provide selected support for the execution of DRPM responsibilities, to include legal, contracting, and comptroller services per an operating agreement signed by the DRPM AAA and the CG, MCRDAC. MCRDAC will serve as the HCA and retains overall administrative fiduciary responsibilities. The Charter identified the AAA as the Marine Corps' number one ground priority and listed the following programs as being assigned to DRPM AAA: the Amphibious Assault Vehicle (AAV7A1 family), AAV Product Improvements (AAV7A1 PIP), Advanced Amphibious Assault (AAA), Stratified Charge Rotary Engine (SCRE), and Marine Corps Assault Vehicles (engineering). In June 1993, LtCol. Feigley replaced the existing PM as DRPM AAA. LtCol Feigley was promoted to Colonel in August 1993.

28. How did the designation as DRPM AAA eliminate the problems associated with the dual reporting chain?
29. What new problems arose when the DRPM AAA program management office was created?
30. What are the potential funding issues and other potential conflicts associated with combining the two program offices and the many different projects?

PROGRAM FUNDING

The stability of program funding is a key concern for any program manager. As the defense budget continued to decline in the early 1990's, programs were at increased risk for sudden cuts in their current and future year program funding. This uncertainty adds to the cost of programs as contractors seek to cover costs resulting from program starts and stops. Funding reductions can result in the program schedule being stretched out, a reduction in performance requirements, and/or a decrease in the quantity of systems purchased.

The AAA program suffered its first significant funding cut in December 1994 with the issuance of Program Decision Memorandum 4. PDM 4 reduced the original FY96-01 Research, Development, Testing and Evaluation (RDT&E) funding stream by $190m, a 35% reduction from the FY 1996 President's Budget. The cuts would cause an already long program to be stretched out an additional two years. The budget cuts were apportioned as follows:

	FY96	FY97	FY98	FY99	FY00	FY01	TOTAL
FY96 Presidential Budget	66.0	85.6	93.4	59.4	104.9	134.2	543.5
PDM 4 Cut	-33.5	-54.1	-41.7	+26.6	-11.9	-75.2	-189.9
Resulting Budget	32.5	31.5	51.7	86.0	93.0	58.9	344.6

* Current $ million

Figure 2

These cuts were to take effect during the PDRR Phase, and would adversely affect planned tests (such as engine, ballistic hull, armor qualification and communications suite tests), requirement trade studies, and delivery of prototypes. Col. Feigley had some difficult decisions to make. Not only would the development and fielding schedule be stretched out further, he had to find $190 million in program savings.

31. Where would you make the cut?
32. Can you "buy back" any of the program later on with Congressional plus-ups? What is the risk of this approach?
33. What are some alternative strategies?
34. What are the contracting implications of a cut in the out-year program budget?

COLONEL FEIGLEY BEGINS PLANNING FOR PDRR

As the AAA program moved closer to the Milestone I DAB Review in March 1995, Col. Feigley began planning for the next phase of the program, PDRR. Drawing on the program management knowledge he had gained over the years, Col. Feigley had some ideas on acquisition reform initiatives that he wanted to implement during the next phase. These initiatives included:

1. DOWN-SELECTION TO ONE CONTRACTOR

Col. Feigley wanted to request an exception to the Competitive Prototyping Requirement of Title 10, United States Code, Section 2438 and down-select to one contractor for the PDRR Phase. This request would be based on the fact that the Government had extensive knowledge of amphibious vehicles and the technology base that had already been developed. Additionally, the two competing AAAV designs were not fundamentally dissimilar from each other or from the Government's own earlier technical base designs. If Col. Feigley could down-select to only one contractor, the full extent of the Government's experience could be imparted on the single prime contractor.

35. What are the risks associated with down-selection to one contractor for PDRR?
36. What were the reasons that major programs during the cold war carried multiple contractors?
37. How do you maintain competition if you have only one contractor?

2. COLLOCATION

Col. Feigley's desire to down-select to one contractor for the PDRR Phase would allow him to obtain another of his goals – the collocation of the PM office with the contractor. Although this was an unusual arrangement, he felt it was critical to the success of the program.

Col. Feigley felt that collocation offered many benefits to both the Government and the contractor. Among these benefits were: reduced program risk; ease of imparting unique Government knowledge and experience with high-speed amphibious vehicles to the contractor; a dramatically reduced decision-making cycle time; increased commitment on the part of employees for program success; and separation from the government and contractor "flagpoles," which would allow acquisition reform initiatives to be more easily implemented. An additional benefit would be the complete indoctrination of Government and contractor employees into the Marine Corps culture and ethos. Col. Feigley reasoned that once all employees (Government and contractor) understood Marines and the environment in which they operated, they would design and build a better vehicle.

Col. Feigley wanted the contractor to locate their research and development facility "within 20 minutes by car of Springfield, Virginia, the intersection of Interstate 95, 395 and 495." The contractor would be required to have all key personnel (listed in the Key Personnel clause of the contract) located at this facility full time. Finally, the contractor would be required to provide the DRPM AAA Program Office with office space (including offices, spaces, furniture and equipment) collocated at the contractor's facility. This is the first time that a Major Defense Acquisition Program (MDAP) has been completely collocated with the prime contractor and its major subcontractors.

The new location would become "neutral ground" for everyone involved on both sides of the AAAV project. This move was necessary to help create the "cultural change" that Col. Feigley envisioned. This cultural change would come about through collocation and the use of Integrated Product and Process Development (IPPD) and Integrated Product Teams (IPTs).

38. What problems, legal or otherwise, could collocation cause the Government and the contractor?
39. How would you indoctrinate Government and contractor employees into the Marine Corps culture and ethos?

40. What are the financial implications to the contractor on the collocation requirement?
41. What are the advantages and disadvantages of the specific geographic area chosen for collocation?

3. Teaming

Col. Feigley realized that to make the AAA program successful, the Government and the contractor would have to adopt a "teaming" approach. Teaming would allow the Government and the contractor to forge a close working relationship based on trust and would help eliminate the adversarial relationship that is typical between the Government and the contractor. Collocation would facilitate the use of IPPD and IPTs.

The DoD 5000.1 Para D.1(b) defines IPPD as:

> ...a management technique that integrates all acquisition activities starting with requirements definition through production, fielding/deployment and operational support in order to optimize the design, manufacturing, business, and supportability processes. At the core of IPPD implementation are Integrated Product Teams (IPTs).

The DoD 5000.1 Para E.2(f) defines IPT as:

> ...composed of representatives from all appropriate functional disciplines working together with a Team Leader to build successful and balanced programs, identify and resolve issues, and make sound and timely recommendations to facilitate decision-making. There are three types of IPTs: Overarching IPTs focus on strategic guidance, program assessment, and issue resolution. Working Level IPTs identify and resolve program issues, determine program status, and seek opportunities for acquisition reform. Program IPTs focus on program execution, and may include representatives from both Government, and after contract award, industry.

The IPPD concept would be used to integrate the design effort. The contractor would be responsible for providing the leadership for each IPT. The Government members on the IPTs would serve as "customer" representatives. They would facilitate contractor personnel getting information faster, thereby reducing cycle time. Since the IPPD and IPT would be a relatively new concept to both the Government and the contractor, an extensive training period would be required to train all personnel.

42. *What type of training would you conduct on IPPD and IPTs?*
43. *Who would you have conduct the training?*
44. *What problems would you anticipate from implementing IPPD and IPTs?*

COLONEL FEIGLEY'S FINAL THOUGHTS

The time for reflection was over. Satisfied that the Marine Corps had passed this latest hurdle, Col. Feigley knew that there was still much work to be done if the Marine Corps was going to finally replace the LVTP7A1. His ideas on collocation and teaming had to be captured in the Request for Proposal; personnel for the Source Selection Evaluation Board had to be identified and trained; program funding issues had to be resolved; and risk management plans must be developed to address the technical risks that he would face during PDRR. It was time to go back to work.

AAAV PROGRAM TIMELINE

1972-1974	LVTP-7 fielded. Service life slated to end in 1984.
1975	LVA program begins. Requirement for OTH operations identified.
1977	LVTP-7 renamed AAVP7.
1979	LVA program cancelled due to size, affordability and maintainability issues. LVT(X) program begins. Requirement for OTH operations cancelled.
1982	SLEP extends service life of AAVP7 to 1994. IOC on LVT(X) moves to 1994.
1985	LVT(X) program cancelled. PMS-310 created at NAVSEA. Technology Base Development program begins at DTRC.
1987-1994	AAVP7 PIP conducted extending service life to 2004.
1988	PDM, ADM issued approving Milestone 0 for the AAA program. IOC for AAAV slated 4th quarter FY 99.
Aug 1989	HWSTD successfully demonstrates planing hull technology at 20 + knots.
Feb/Apr 1990	First set of concept study contracts issued to FMC and GDLS.
Aug 1990	ASN(RDA) charters DRPM, AAA. Includes both AAV and AAAV programs.
Mar 1991	COEA completed. AAAV identified as best of 13 alternatives.
Apr 1991	MCPDM delays MS I DAB review. Mandates Red Team analysis of risks.
Jul 1991	First Red Team assessment completed.
Feb 1992	PSD achieves 28.7 kts in demonstration to key acquisition officials.
Sep 1992	FMC and GDLS awarded second set of concept studies contracts.
Nov 1992	Second Red Team assessment completed.
Feb 1993	Updated COEA validates 1991 COEA findings.
Jun 1992	AAA program split up. Col. Feigley becomes DRPM, AAA. PM, AAV assigned to MCRDAC.
Jul 1993	Additional risk reduction contracts awarded to FMC and GDLS.
Aug 1994	USD(A&T) asks SecNav to develop cheaper alternative to AAAV.
Nov 1994	Third Red Team assessment completed.
Dec 1994	PDM-4 reduces FY 96-01 funding by $190M. Program stretched over 2 years.
Mar 1995	MS I approval. AAAV program enters Concept Demonstration/Validation phase. AAAV MS II DAB planned for Jan 2002 and IOC scheduled for December 2007.
Jun 1995	Dem/Val RFP released; proposals due in Sep 1995.
Oct 1995	PDM-2 restores $107M in FY 96-01 funding.

Attachment 1

Colonel James M. Feigley
Direct Reporting Program Manager, Advanced Amphibious Assault

Colonel Feigley joined the Marine Corps' Platoon Leaders Class pre- commissioning program in December 1969 while an undergraduate student at the University of Wisconsin - Oshkosh. After receiving his Bachelor of Science degree in 1972, he was commissioned a Second Lieutenant and attended infantry officers training at The Basic School, Quantico, Va. Upon graduation in 1973 he was ordered to the 3rd Marine Division in Okinawa, Japan, and was assigned to the 1st Amphibian Tractor Battalion. Soon thereafter, he deployed with Battalion Landing Team 1/9 to the western Pacific as a Tracked Vehicle Platoon Commander. In 1974 he was promoted to First Lieutenant and was ordered to the Marine Corps Recruit Depot, San Diego, Calif., where he served as a Recruit Series Commander and the Officer in Charge of the Physical Training Unit.

He was promoted to Captain in 1977 and was subsequently ordered to attend the Amphibious Warfare School at Quantico, Va. Upon his graduation in 1978, he was ordered to the 2nd Marine Division at Camp Lejeune, N.C. and was assigned to the 2nd Assault Amphibian Battalion. While there, he served as a Company Executive Officer, Company Commander, and Battalion Operations Officer, and deployed with Regimental Landing Teams Two and Eight for NATO exercises in Northern Europe and the eastern Mediterranean. In 1981 he was ordered for duty with the 3rd Marine Division in Okinawa, Japan and assigned to the 1st Tracked Vehicle Battalion. There he served as a Company Commander and deployed with his unit to Korea for Joint Allied exercises. In 1982 he was promoted to Major and ordered to the Naval Training Equipment Center, Orlando, Fla., as a Liaison Officer and later, the Project Manager for Marine Corps ground training and simulation equipment. During his tour, he attended the Project Managers Development Course at the Army Logistics Management Center, Ft. Lee, VA.

Following his selection for career level school in 1985, he attended the Marine Corps Command and Staff College in Quantico, VA. Upon graduation in 1986, he was ordered to Headquarters, U.S. Marine Corps, Washington, D.C., to serve as a project officer in the Weapons Branch, Office of Deputy Chief of Staff for Installations and Logistics. Following reorganization of Marine Corps development and procurement activities, he was assigned to the newly formed Marine Corps Research, Development, and Acquisition Command, Washington,

Attachment 2

D.C. as a Project Officer in the Armored Combat Vehicle Directorate. During this tour of duty he attended the Program Managers Course at the Defense Systems Management College, Ft. Belvoir, VA. Upon Marine Corps initiation in 1988 of a major defense program to replace the current fleet of assault vehicles, he was transferred first to the Naval Sea Systems Command, Washington, D.C. and subsequently to the Department of the Navy, Direct Reporting Program Manager, Advanced Amphibious Assault office for duty as the Assistant Program Manager. In August of 1989 he was promoted to the rank of Lieutenant Colonel.

Colonel Feigley was assigned as the Direct Reporting Program Manager, Advanced Amphibious Assault during June 1993. He was promoted to the rank of Colonel in August 1993. His personal decorations include the Legion of Merit, Meritorious Service Medal, Navy Commendation Medal, and the Navy Achievement Medal with gold star.

DEPARTMENT OF THE NAVY
HEADQUARTERS UNITED STATES MARINE CORPS
WASHINGTON, D.C. 20380

CMC: RD
29 Jan 1979

MEMORANDUM FOR THE UNDER SECRETARY OF DEFENSE FOR RESEARCH AND ENGINEERING

Subj: Landing Vehicle Assault (LVA) Program

1. This is to advise you that I have decided to cancel the Marine Corps requirement for the high speed amphibian assault vehicle which we refer to as the Landing Vehicle Assault (LVA). This development program is carried under Program Element 63611N in the Marine Corps RDT&E budget. Our Mission Element Need Statement (MENS), subject: Amphibious Warfare Surface Assault was approved by Secretary Duncan on 2 October 1978. The MENS presents three alternatives for DSARC I which is tentatively scheduled in September 1979. My cancellation of the requirement for the LVA will reduce the alternatives to two, the LVT(X) and the Army Infantry Fighting Vehicle (IFV), with the LVT(X) the preferred Marine Corps alternative.

2. An intensive review has been made of Marine Corps requirements for effectively conducting the surface portion of the ship-to-shore movement in an amphibious assault against a defended objective area. After consultation with the Chief of Naval Operations and with the consideration of the projected threat of the 1980's and 1990's, I have concluded that the initial assault waves of the Marine Corps amphibious surface assault can be launched effectively from distances considerably less than the 15 to 25 miles envisioned in our Concepts 85 Study. This eliminates the previously overriding requirement that the Marine Corps develop the LVA which would be capable of moving ashore at speeds between 25 and 40 knots.

3. A key factor that has reinforced my decision to cancel the LVA requirement is the large size of the LVA vehicle as proposed by industry. A vehicle of such large size will be very vulnerable when operating ashore, due to the lucrative target that it could present to anti-armor weapons. The technology of developing a heavy, high density vehicle to plane on top of the water at high speed has resulted in an excessive size of the LVA. The Marine Corps is not prepared to accept the casualties that can be foreseen with the LVA engaged in land combat.

Attachment 3

CMC: RD
29 Jan 1979

Subj: Landing Vehicle Assault (LVA) Program

A second factor in my decision is that I have concluded that the Marine Corps cannot afford to procure the LVA. The development cost is projected to be in excess of $300.0M, and the procurement cost is projected to be approximately $1.4B for 1000 vehicles. A third consideration is that I believe that the LVA as developed by industry would be extremely difficult to maintain in the field. By virtue of the vehicle complexity required to achieve the high water speed, a significant maintenance burden would have to be accepted.

4. As an alternative under our approved Mission Element Need Statement (MENS), the Marine Corps will pursue the development of the LVT(X) as the follow-on amphibious assault vehicle to the presently operational LVT-7 family of amphibians. The LVT(X) will be a low water speed amphibian. It will be very mobile ashore, with a low silhouette, much smaller in size than the LVA, somewhat smaller in size than the present LVT-7, simple in design, and it will be easier to maintain than the LVA. Most importantly, the LVT(X) must be an amphibian vehicle that the Marine Corps can afford to develop and procure. Our tentative date for initial operational capability (IOC) for, the LVT(X) would be 1986.

5. To date approximately $20.0M has been expended on the LVA program. Slightly over one-half of this amount has been directed toward rotary engine development effort. In this regard the development of the rotary engine should continue since the engine has application to numerous vehicles. The rotary engine will be much smaller than current diesel engines, will weigh less than half as much as a diesel engine with equal horsepower, and is expected to demonstrate competitive fuel economy. We would anticipate using the rotary engine (at 750 horsepower) in both the LVT(X) and the Mobile Protected Weapon System (MPWS). Of the remaining funds spent to date (about $9.0M), all but approximately $3.0M have been utilized in general technology areas that are applicable to the LVT(X) as well as the LVA. Our FY79 budget includes $12.0M for the LVA program. About $7.0M of this supports the rotary engine development, and the remainder would be required to accelerate the pace for the LVT(X). The $17.8M requested in FY80 should be directed to the LVT(X) program, assuming that the LVT(X) is the alternative chosen at DSARC I. We will appreciate your support in this regard during the FY80 budget hearings before the Congress.

CMC: RD
29 Jan 1979

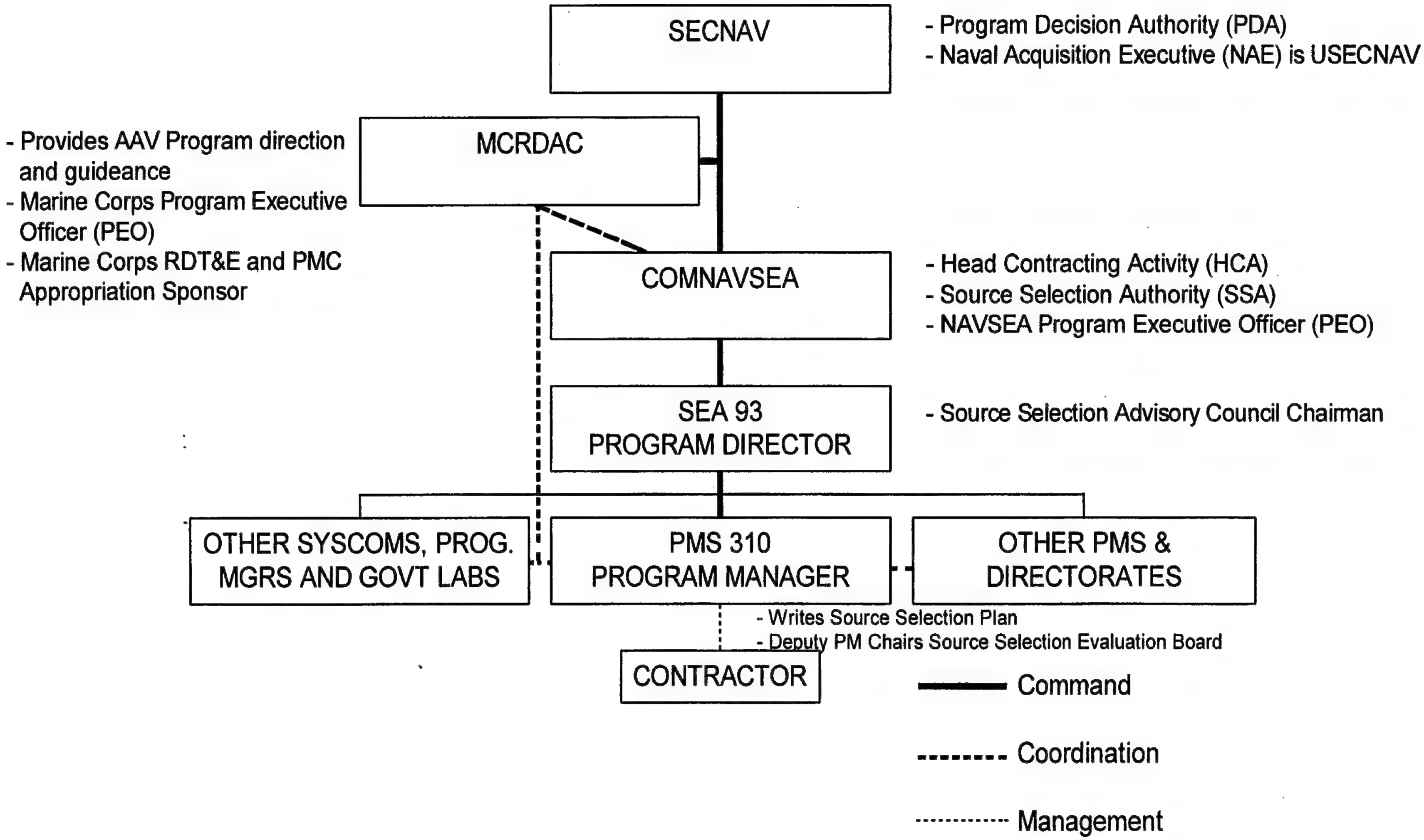
Subj: Landing Vehicle Assault (LVA) Program

6. Secretary Claytor, Admiral Hayward, and I are scheduled to appear before the House Armed Services Committee on 2 February. It is my intention that I would make the first public announcement of the LVA program cancellation at that hearing. Prior to that date I would like to formally notify the four Defense Committee Chairmen of my decision to cancel this $l.7B alternative. The LVA was an alternative that the Marine Corps simply could not afford, either in cost, complexity, maintainability, or vulnerability in land combat. I have discussed this matter with Secretary Claytor. I would appreciate the opportunity to discuss the termination of the LVA Program with you at an early date, and I believe that it is essential that we do so prior to commencement of my FY80 Congressional hearings.

//signed//
LOUIS H. WILSON
General, U. S. Marine Corps
Commandant of the Marine Corps

Copy to:
ASN(RE&S)

Acquisition Relationships, PM-AAV within PMS-310



Attachment 4

COST AND OPERATIONAL EFFECTIVENESS ANALYSIS (COEA)

After material alternatives have been identified, a COEA must be conducted. A COEA is an analysis of the estimated costs and operational effectiveness of alternative material systems to meet a mission need and the associated program for acquiring each alternative. The first COEA was initiated in September 1989 and was approved by MCRDAC in March 1991. The Acquisition Decision Memorandum for Milestone 0 directed by the Marine Corps to expand the scope of the AAA Program by "examining all alternatives of placing infantry ashore, not just a new amphibious vehicle." Accordingly, thirteen alternatives broken down into four broad categories were considered during this COEA. The alternatives were:

Category	**Alternatives**
High-Speed Amphibian	AAAV (Fast) AAV7A2 (Fast)
Slow-Speed Amphibian	AAV7A1 (current system) AAAV (Slow) AAV7A2 (Slow) Submersible
Non-Amphibians	U. S. Marine Corps LAV-25 U.S. Army M113A3 Armored Personnel Carrier U.S. Army M2A2 Bradley Fighting Vehicle Armored Personnel Carrier (APC-X) Future Infantry Fighting Vehicle (FIFV)
Non-Vehicles	Surface option (using LCAC) Air option (using helicopters)

Conducting a COEA on thirteen alternatives is very expensive and time consuming. To reduce this number to a more manageable number, a preliminary Performance Analysis that addressed ship-to-shore movement, system mobility ashore, survivability, and lethality was conducted. This preliminary analysis resulted in the elimination of six alternatives - the AAV7A2 (F), submersible, LAV-25, M2A2 Bradley Fighting Vehicle, FIFV, and the all air option. Although the AAV7A1 and the M113A3 also performed poorly in the preliminary performance analysis, they were retained for further analysis. The AAV7A1 was retained to function as a baseline comparison and the M113A3 was retained due to its extremely low cost.

The remaining seven alternatives underwent an Operational Effectiveness Analysis based on measures of effectiveness (MOEs) produced by a large, force-on-force simulation using multiple scenarios. As a result of this analysis, the AAV7A1, AAV7A2 (S), the surface option, and the M113A3 were eliminated.

Attachment 5

The COEA then analyzed the remaining three alternatives - AAAV (F), AAAV (S), and the APC (X). The selection of the best alternative required a balanced judgment of analytically derived operational effectiveness; affordability; operational necessity; service missions, doctrine and tactics; technical risk; future threat capabilities; the application of operational military art; and the overall opinion of military worth. The AAAV (F) proved to be the most operationally effective, and the most costly in terms of individual vehicle costs. However, when potential savings from not having to buy additional ships and LCACs (which would be needed to support the AAAV (S) and the APC (X)) is considered, the AAAV (F) also becomes the most cost effective.

EXECUTIVE SUMMARY

This working paper summarizes the findings of a technical assessment of two concepts and two alternative acquisition strategies for the Advanced Amphibious Assault Vehicle (AAAV). The technical assessment was performed by the Office of Advanced Technology (OAT), Chief of Naval Research, at the request of the Assistant Secretary of the Navy for Research, Development and Acquisition. This report updates previous technical assessments by OAT done in July 1991 and June 1992 and includes the results of several risk reducing efforts completed for the program.

FMC and General Dynamics Land Systems (GDLS) updated their baseline concepts for the AAAV and described changes to -the baseline concepts to accommodate two alternative acquisition approaches, the AAAV(M) and AAAV(Block V). These strategies use two different approaches to phased development and result in a mixed fleet of high waterborne speed and slow waterborne speed AAAVS. The fast variant would meet all AAAV operational requirements and the slow variant would meet all AAAV operational requirements except for the high waterborne speed.

The significant findings of this technical assessment are:

- Analyses and changes to the FMC and GDLS concepts for the AAAV during the past year have been effective in reducing the technical risk.

- Full-scale prototype development and tests of the high waterborne speed vehicles are necessary to resolve the principal areas of risk.

- The principal areas of risk in the AAAV are:

- High waterborne speed ability. The critical areas of risk associated with achieving high waterborne speed are vehicle weight, propulsor efficiency and engine development. Specifically, for the FMC AAAV(M) and AAAV(Block V) high speed variant, the development of an air handling system to prevent water ingestion into the gas turbine is considered to be an area of high risk.

- Appendage robustness. Ensure that hydrodynamic appendages perform in the specified environment and fail gracefully in more severe environments.

Attachment 6

Design integration. The current AAAV(M) acquisition schedule shows development and test of the slow speed variant before the fast speed variant. The modularity desired to provide flexibility to convert from slow to high speed variants and the use of a gas turbine and diesel engine combination in the FMC concept also are principal contributors to the risk.

The significant recommendations are:

- Initiate full-scale prototype design, development and test of the high speed vehicles.

- Revise the AAAV(M) acquisition schedule to develop and test the high speed variant before or concurrent with the slow speed variant.

- Determine whether AAAV operational requirements should be revised to reduce technical risk.

- Pursue parallel development of power plants until success is assured in one of the selected engine combinations.

- Continue developments that support potential weight reductions.

- Investigate the effect on technical risk of reducing or eliminating the modular conversion capability in the AAAV(M) and AAAV(Block V) concepts.

GLOSSARY OF ACRONYMS

AAA	Advanced Amphibious Assault
ACAT 1D	Acquisition Category 1D
ADM	Acquisition Decision Memorandum
AMTRAC	Amphibian Tractor
ATR	Automotive Test Rig
AAV	Assault Amphibian Vehicle
AAAV	Advanced Amphibious Assault Vehicle
AAAV(V)	Advanced Amphibious Assault Vehicle (Block V)
AAAV(M)	Advanced Amphibious Assault Vehicle (Modular)
ASN(RDA)	Assistant Secretary of the Navy for Research, Development and Acquisition
AWS	Amphibious Warfare Strategy
AWSA	Amphibious Warfare Surface Assault
AWT	Amphibious Warfare Technology
CE	Concept Exploration
CG, MCDEC	Commanding General, Marine Corps Development and Education Center
CG, MCRDAC	Commanding General, Marine Corps Research, Development and Acquisition Command
CMC	Commandant of the Marine Corps
CNO	Chief of Naval Operations
COEA	Cost and Operational Effectiveness Analysis
COMNAVSEA	Commander, Naval Sea Systems Command
CPFF	Cost-Plus-Fixed-Fee
DAB	Defense Acquisition Board
DoD	Department of Defense
DoN	Department of the Navy
DRPM	Direct Reporting Program Manager
DRPM AAA	Direct Reporting Program Manager Advanced Amphibious Assault
EMD	Engineering and Manufacturing Development
FFP	Firm-Fixed Price
FY	Fiscal Year
GDLS	General Dynamic Land Systems
HCA	Head Contracting Agency
HWSTD	High Water Speed Technology Demonstrator
ICE	Independent Cost Estimate
IFV	Infantry Fighting Vehicle
IOC	Initial Operational Capability
IPPD	Integrated Product and Process Development
IPT	Integrated Product Team
J&A	Justification and Approval

GLOSSARY OF ACRONYMS (cont.)

LCAC	Landing Craft, Air Cushioned
LVA	Landing Vehicle, Assault
LVT-1	Landing Vehicle, Tracked Model 1
LVT(X)	Landing Vehicle, Tracked (Experimental)
MAA	Mission Area Analysis
MAGTF	Marine Air-Ground Task Force
MCDEC	Marine Corps Development and Education Center
MCPDM	Marine Corps Program Decision Meeting
MCRDAC	Marine Corps Research, Development and Acquisition Command
MDAP	Major Defense Acquisition Program
MENS	Mission Element Needs Statement
MNS	Mission Needs Statement
MS	Milestone
NAE	Naval Acquisition Executive
NAVSEA	Naval Sea Systems Command
NSWC-CD	Naval Surface Warfare Center - Carderock Division
OAT	Office of Advanced Technology
ONR	Office of Naval Research
ORD	Operational Requirements Document
OTH	Over-The-Horizon
PDA	Program Decision Authority
PDM	Program Decision Memorandum
PDRR	Program Definition and Risk Reduction
PEO	Program Executive Officer
PIP	Product Improvement Program
PLCCE	Program Life-Cycle Cost Estimate
PM	Program Manager
PMAAV	Project Manager, Assault Amphibian Vehicles
POM	Program Objective Memorandum
PSD	Propulsion System Demonstrator
RDT&E	Research, Development, Test and Evaluation
ROC	Required Operational Capability
SECNAV	Secretary of the Navy
SESSO	Surface Effects Ship Support Office
SCRE	Stratified Charge Rotary Engine
SLEP	Service Life Extension Program
USD(A)	Under Secretary of Defense, Acquisition

ENDNOTES

1 Krulak, LtGen. V. H., First To Fight, (Naval Institute Press, Annapolis, Maryland,
1984), p. 77.

2 Roan, Maj. R. W., Roebling's Amphibian: The Origin of the Assault Amphibian,
(Marine Corps Development and Education Command, Quantico, Virginia, May 6
1987), p. 46.

3 Krulak, pgs. 105-108.

4 Croizat, Col. V. J., "Fifty Years of Amphibian Tractors," Marine Corps Gazette,
March 1989, p. 71.

5 Ibid. p. 74.

6 Ibid. p. 75.

7 Marine Corps Gazette, January 1986, p. 80.

8 Naval Institute Proceedings, January 1986, p. 24.

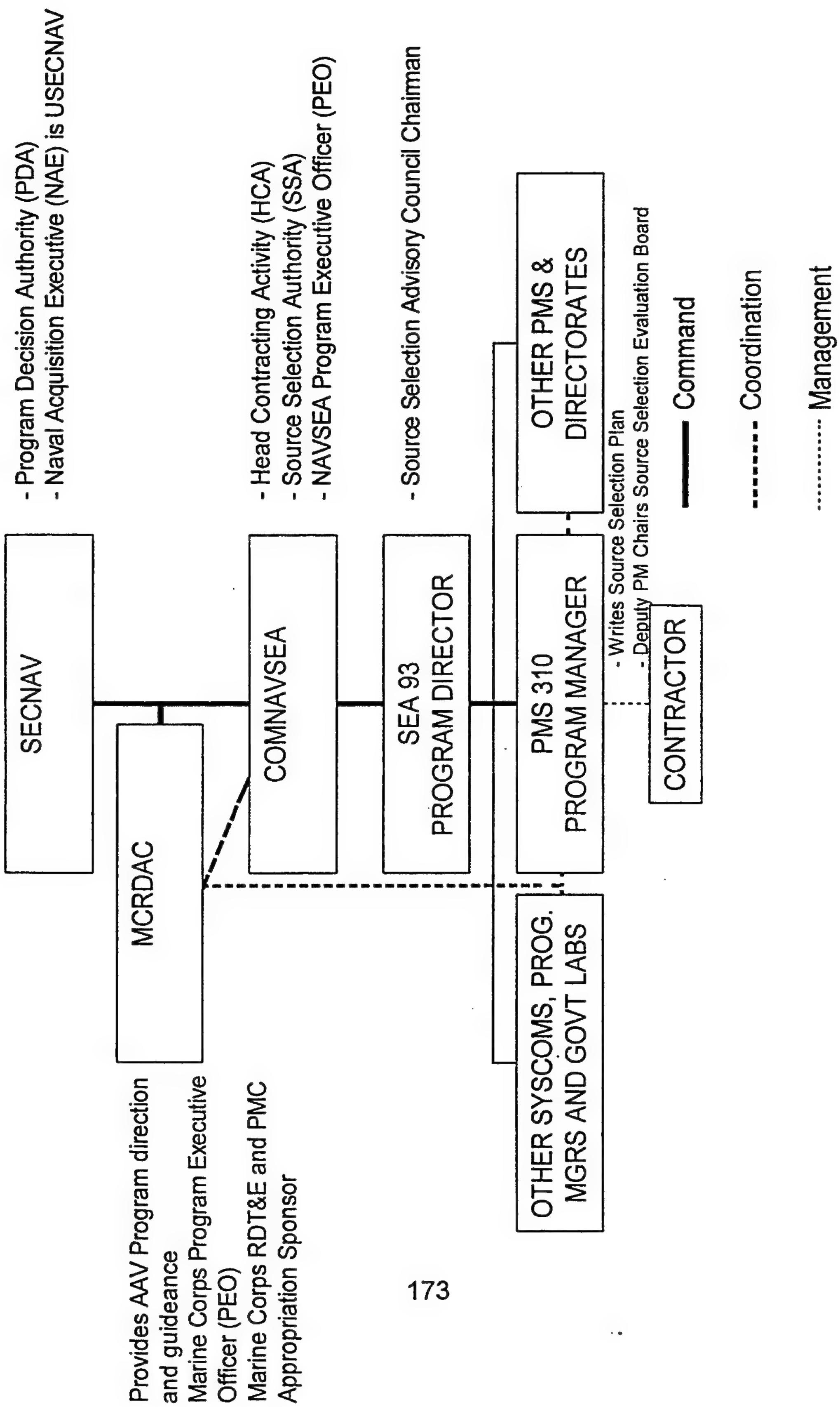
9 Ibid. p. 28.

10 Ibid. p. 28.

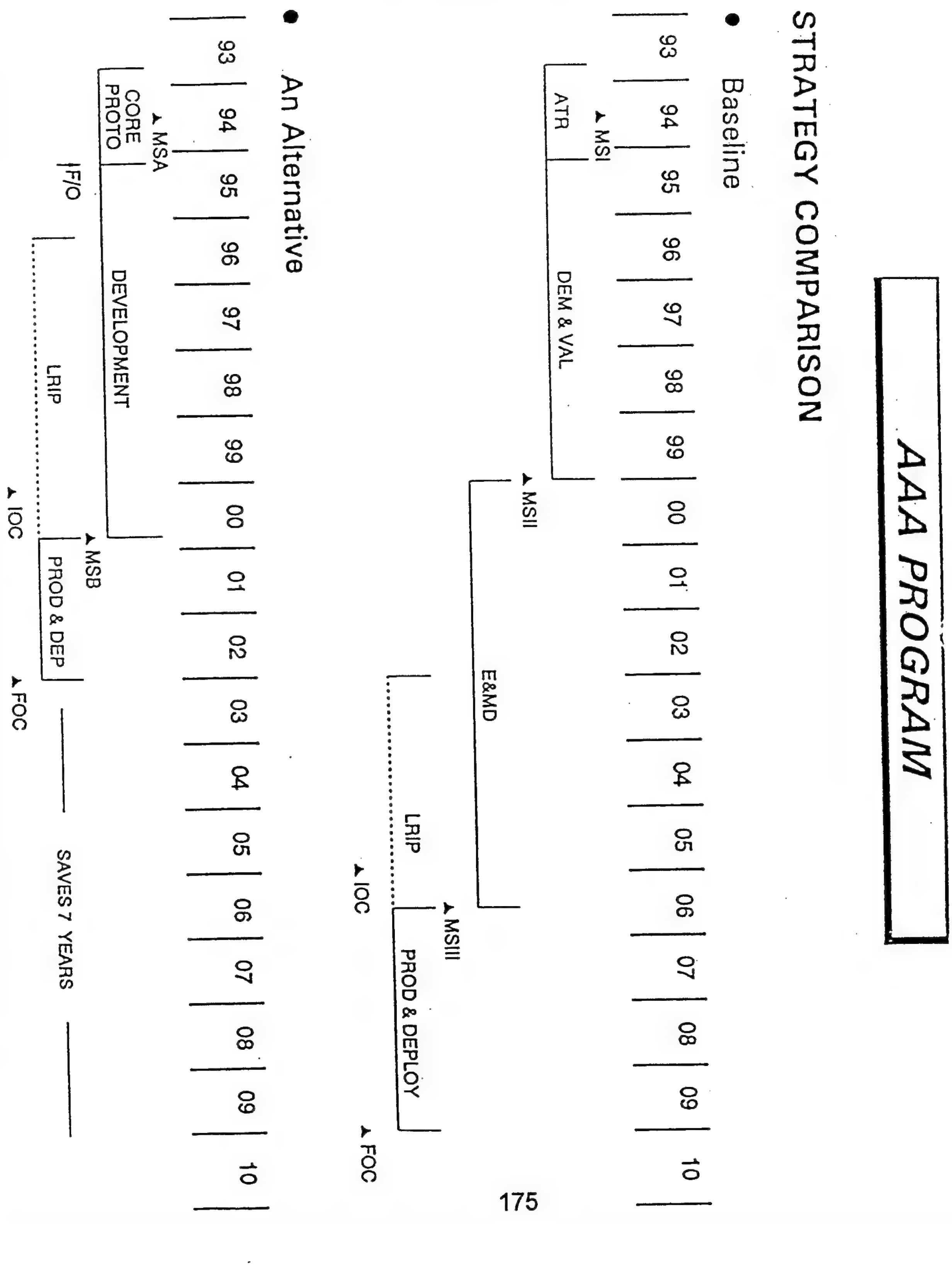
11 Ibid. p. 20.

12 Amphibious Warfare Review, Winter 1989, p. 37.

APPENDIX B: ACCQUISITION RELATIONSHIPS WITHIN PMS-310



APPENDIX C: COMPARISON BETWEEN THE BASELINE AAAV PROGRAM SCHEDULE AND THE EVOLUTIONARY ACQUISITION STRATEGY PROGRAM SCHEDULE



APPENDIX D: COST AND OPERATIONAL EFFECTIVENESS ANALYSIS (COEA) FOR THE AAAV PROGRAM

After material alternatives have been identified, a COEA must be conducted. A COEA is an analysis of the estimated costs and operational effectiveness of alternative material systems to meet a mission need and the associated program for acquiring each alternative. The first COEA was initiated in September 1989 and was approved by MCRDAC in March 1991. The Acquisition Decision Memorandum for Milestone 0 directed by the Marine Corps to expand the scope of the AAA Program by "examining all alternatives of placing infantry ashore, not just a new amphibious vehicle." Accordingly, thirteen alternatives broken down into four broad categories were considered during this COEA. The alternatives were:

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Conducting a COEA on thirteen alternatives is very expensive and time consuming. To reduce this number to a more manageable number, a preliminary Performance Analysis that addressed ship-to-shore movement, system mobility ashore, survivability, and lethality was conducted. This preliminary analysis resulted in the elimination of six alternatives - the AAV7A2 (F), submersible, LAV-25, M2A2 Bradley Fighting Vehicle, FIFV, and the all air option. Although the AAV7A1 and the M113A3 also performed poorly in the preliminary performance analysis, they were retained for further analysis. The AAV7A1 was retained to function as a baseline comparison and the M113A3 was retained due to its extremely low cost.

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would be needed to support the AAAV (S) and the APC (X)) is considered, the AAAV (F) also becomes the most cost effective. The overall conclusion was that the AAAV (F) was the best the best choice.

The COEA was expanded in February 1992 to look at two new procurement strategies. The new procurement strategies were referred to as AAAV(M) and AAAV(V). These strategies were similar in that they called for a mixed fleet approach. "Fast" swimmers would be fielded for all amphibious ships and "Slow" swimmers would be fielded to fill all remaining requirements. The AAAV(M) strategy used a traditional new vehicle development approach with an imbedded modular design. A new low water speed amphibious vehicle would be built with the high-speed attributes of weight, space and required structural design included. When the high water speed specific components were designed and produced, they would be installed in some of the vehicles. The AAAV(V) block upgrade strategy used the existing AAV7A1 and its deficiencies were prioritized. When material solutions for the deficiencies were found, the technology would be inserted into the AAV7A1. After further analysis, the result of the second COEA was the same as the first COEA. The AAAV (F) was still the best performing and most cost effective option.

APPENDIX E: AAAV SYSTEM DESIGN DECISION PROVISION

H-19 SPECIAL PROVISION REGARDING AAAV SYSTEM DESIGN DECISIONS

a) It is mutually understood and agreed that critical decisions made by the Contractor in designing the Advanced Amphibious Assault Vehicle (AAAV) System will be based upon the results of whole system core capabilities cost/performance trade-off analyses, as well as subsystem and component cost/performance trade-off analyses, which will consider overall AAAV Program objectives such as vehicle weight, combat effectiveness, design-to-unit production cost (DTUPC) and total life cycle cost (LCC) for the AAAV System.

b) It is further recognized that situations may occur in which such trade-off analyses clearly indicate the desirability of design decisions which would significantly increase the Contractor's costs of performance during the Demonstration/Validation (Dem/Val) Phase because of substantially greater long-term benefits to the AAAV Program resulting from anticipated savings in subsequent Program Phases and/or lower life cycle costs throughout the service life of the AAAV.

c) In recognition of the above, the parties mutually agree that whenever the Contractor shall consider making a design decision which the Contractor reasonably expects to significantly increase its costs of certain Dem/Val Phase effort (approximately $500,000 or greater) over the estimated costs included by

the Contractor for such effort in its Best and Final Offer for the Dem/Val Phase Contract, the Contractor may submit to the Contracting Officer:

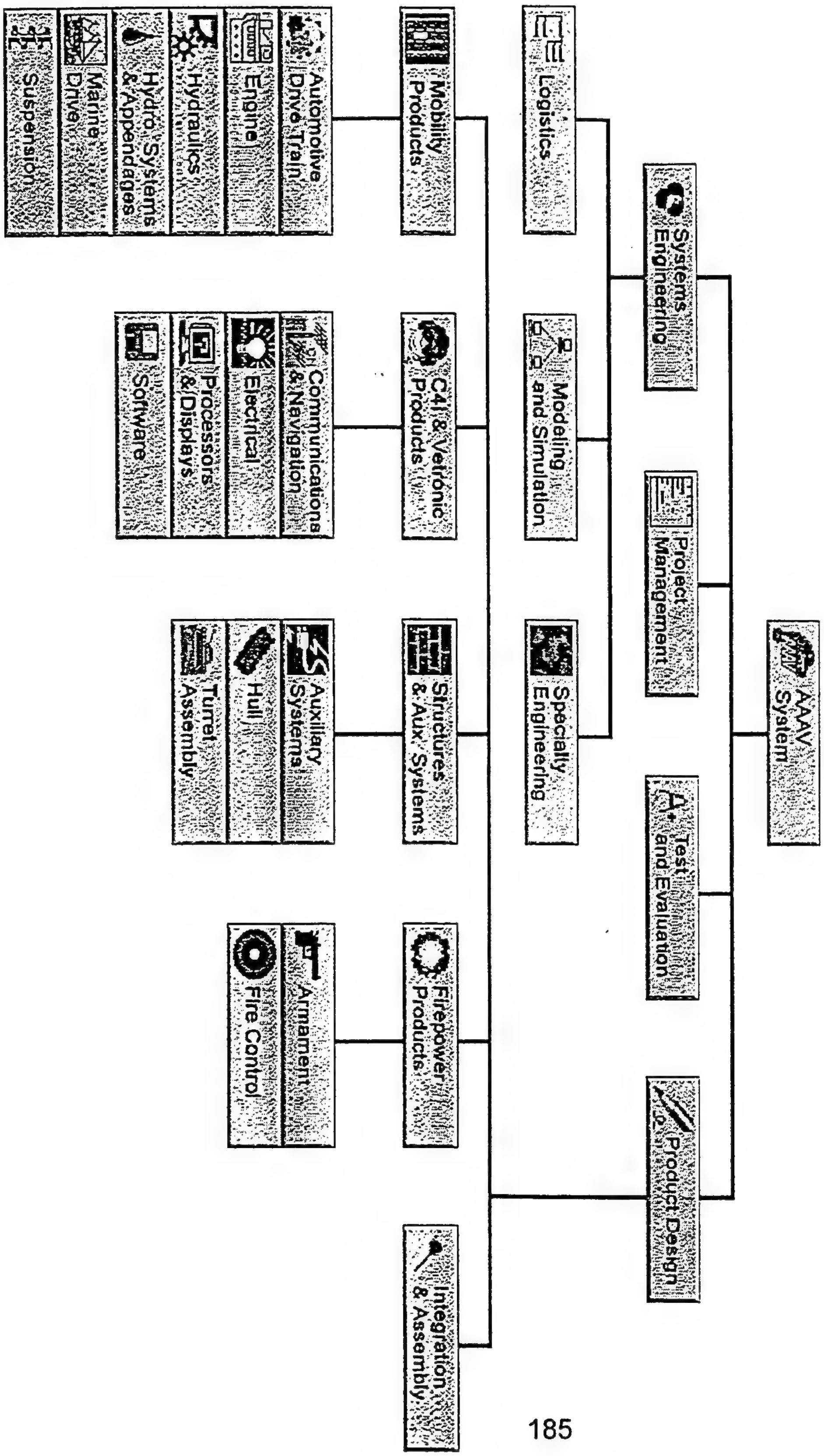
1) the Contractor's estimated Dem/Val costs to implement the contemplated design decision, with supporting documentation;
2) the Contractor's estimate of Dem/Val costs for other acceptable design alternatives;
3) the detailed basis for the Contractor's estimate for the effort contained in its Dem/Val Cost Proposal;
4) the Contractor's assessment of the anticipated long-term benefits to the AAAV Program associated with the design decision; and
5) any additional supporting documentation requested by the Contracting Officer.

d) Upon consideration of the above information, if the Government determines that the overall, long-term benefits to the Marine Corps substantially outweigh the additional costs to be incurred by the Contractor during the Dem/Val Phase, the Contract will be equitably adjusted to reflect the Contractor's anticipated increase in Dem/Val costs (including FCCM and fee) resulting from said design decision.

e) It is understood and agreed that, except with respect to design decisions implemented prior to the effective date of the modification incorporating this clause into the Contract, no request for equitable adjustment hereunder will be considered unless the Contractor's request was received and fully considered by the Government prior to effecting the design decision. It is further understood and agreed that, with regard to any design decision for which an equitable adjustment is made pursuant to this clause, the Contractor shall not be entitled to submit any subsequent change proposals pursuant to the clause of this contract entitled "VALUE ENGINEERING (MAR 1989)," FAR 52.248-1.

f) The Contractor further agrees that decisions regarding equitable adjustments to the contract under this clause are within the sole discretion of the Government. Accordingly, any decision(s) by the Government that the Contractor shall not be entitled to an equitable adjustment hereunder with regard to any contemplated design decision(s) shall not be subject to the provisions of the clause of this Contract entitled "DISPUTES - ALTERNATE I (DEC 1991)," FAR 52.233-1, and the Contractor hereby releases the Government from all liability and forever waives any actual or potential entitlement to any equitable adjustment in the price (cost and fee) and/or delivery schedule of this Contract as a result of any such decision(s).

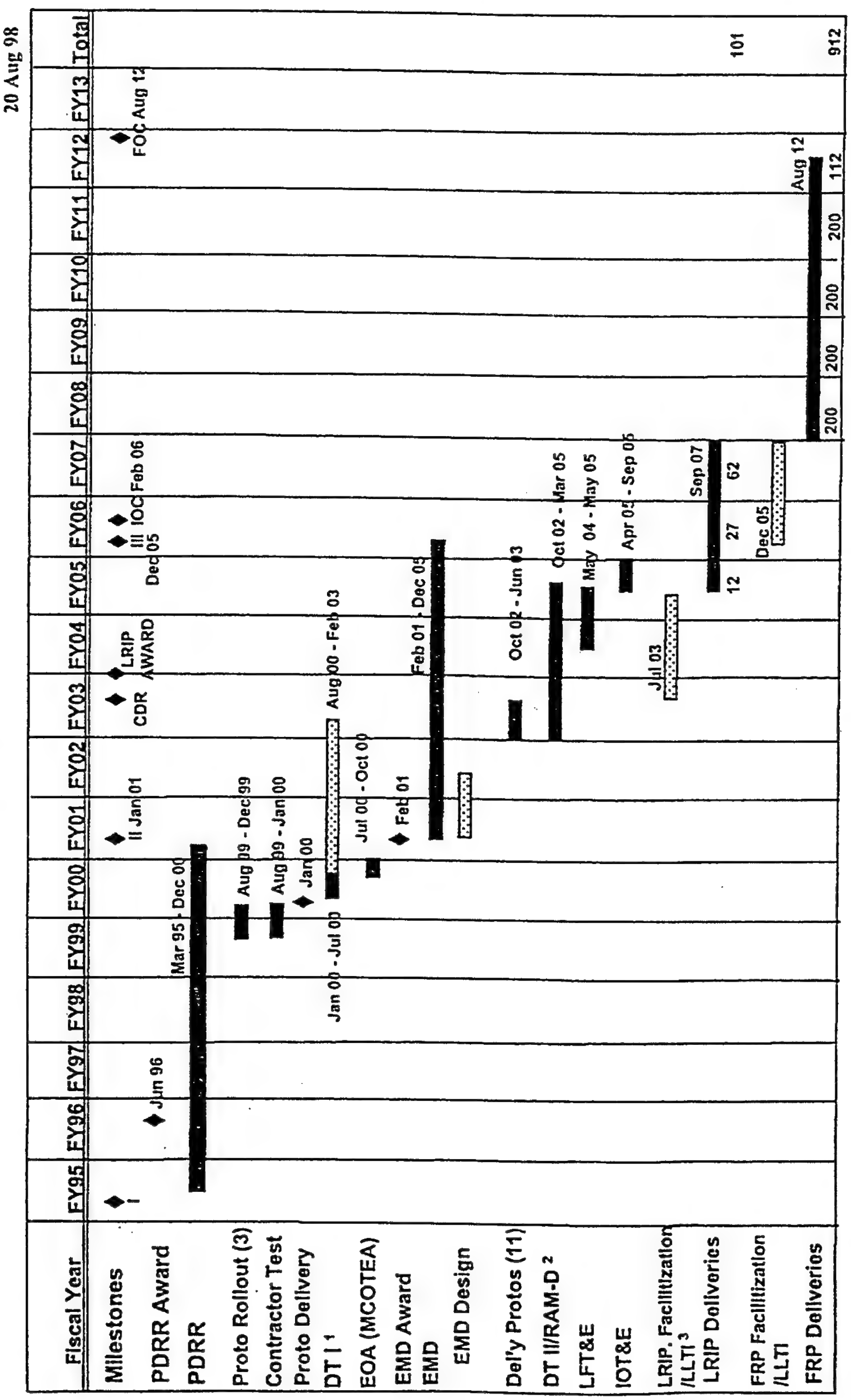
APPENDIX F: AAAV INTEGRATED PRODUCT TEAMS



APPENDIX G: AAAV INTEGRATED PROGRAM SCHEDULE

AAAV Integrated Schedule

20 Aug 98



¹ PDRR vehicle tests continue for the period Aug 00 to Feb 03 for EMD design solutions and the accumulation of reliability data.

² 2 EMD vehicles go to LFT&E; 9 vehicles continue RAM-D testing for Apr 04 to Mar 05.

³ Long lead time items (LLTI) that are not affected by redesign.

APPENDIX H: GLOSSARY OF ACRONYMS

AAA	Advanced Amphibious Assault
AAAV	Advanced Amphibious Assault Vehicle
AAAV(M)	Advanced Amphibious Assault Vehicle (Modular)
AAAV(V)	Advanced Amphibious Assault Vehicle (Block V)
AAV	Assault Amphibian Vehicle
ACAT	Acquisition Category
ACV	Air Cushion Vehicle
ADM	Acquisition Decision Memorandum
AMTRAC	Amphibian Tractor
APB	Acquisition Program Baseline
APM	Assistant Program Manager
ASN (RDA)	Assistant Secretary of the Navy for Research, Development and Acquisition
ATR	Automotive Test Rig
AWSA	Amphibious Warfare Surface Assault
AWT	Amphibious Warfare Technology
CAE	Component Acquisition Executive
CAIV	Cost As an Independent Variable
CDR	Critical Design Review
CE	Concept Exploration
CE/D	Concept Exploration and Definition
CG, MCDEC	Commanding General, Marine Corps Development and Education Center
CI	Commercial Item
CMC	Commandant of the Marine Corps
CNO	Chief of Naval Operations
COEA	Cost and Operational Effectiveness Analysis
COMMMARCORSYSCOM	Commander, Marine Corps Systems Command
COMNAVSEA	Commander, Naval Sea Systems Command
CPAF	Cost-Plus-Award-Fee
CPFF	Cost-Plus-Fixed-Fee
CPIF	Cost-Plus-Incentive-Fee
DAB	Defense Acquisition Board
DAE	Defense Acquisition Executive
DAWIA	Defense Acquisition Workforce Improvement Act
Dem/Val	Demonstration and Validation
DoD	Department of Defense
DODD	Department of Defense Directive
DON	Department of the Navy
DRPM AAA	Direct Reporting Program Manager Advanced Amphibious Assault
DT	Development Test

DT&E	Developmental Test and Evaluation
EOA	Early Operational Assessment
EMD	Engineering and Manufacturing Development
FAR	Federal Acquisition Regulation
FCCM	Facilities Capital Cost of Money
FFP	Firm-Fixed-Price
FMC	Food Machinery Corporation
FMS	Foreign Military Sales
FOC	Full Operational Capability
FSD	Full-Scale Development
FUED	First Unit Equipped Date
FY	Fiscal Year
GDAMS	General Dynamics Amphibious Systems
GDLS	General Dynamics Land Systems
HCA	Head of the Contracting Activity
HSU	Hydrodynamic Suspension Unit
HWSTD	High Water Speed Technology Demonstrator
ICE	Independent Cost Estimate
IFV	Infantry Fighting Vehicle
IOC	Initial Operational Capability
IPPD	Integrated Product and Process Development
IPS	Integrated Program Summary
IPT	Integrated Product Team
J&A	Justification and Approval
LAV	Light Armored Vehicle
LCAC	Landing Craft, Air Cushion
LCVP	Landing Craft, Vehicle and Personnel
LRIP	Low Rate Initial Production
LSF	Landing Ship Fast
LVA	Landing Vehicle Assault
LVT	Landing Vehicle Tracked
LVT-1	Landing Vehicle, Tracked Model 1
LVT (X)	Landing Vehicle, Tracked (Experimental)
MAA	Mission Area Analysis
MCDEC	Marine Corps Development and Education Center
MCPDM	Marine Corps Program Decision Meeting
MCRDAC	Marine Corps Research, Development and Acquisition Command
MDA	Milestone Decision Authority
MDAP	Major Defense Acquisition Program
MENS	Mission Element Need Statement
MNS	Mission Needs Statement
MOA	Memorandum of Agreement
MS	Milestone

MSARC	Major System Acquisition Review Committee
NAE	Navy Acquisition Executive
NAVSEA	Naval Sea Systems Command
NBC	Nuclear, Biological and Chemical
NDI	Nondevelopmental Item
NSWC-CD	Naval Surface Warfare Center - Carderock Division
OAT	Office of Advanced Technology
OMFTS	Operational Maneuver From The Sea
ONR	Office of Naval Research
ORD	Operational Requirements Document
OSD	Office of the Secretary of Defense
OT	Operational Test
OT&E	Operational Test and Evaluation
OTH	Over-The-Horizon
PDA	Program Decision Authority
PDM	Program Decision Memorandum
PDR	Preliminary Design Review
PDRR	Program Definition and Risk Reduction
PEO	Program Executive Officer
PIP	Product Improvement Program
PLCCE	Program Life-Cycle Cost Estimate
PM	Program Manager
PMAAV	Project Manager, Assault Amphibian Vehicles
PMO	Program Management Office
POM	Program Objective Memorandum
PSD	Propulsion System Demonstrator
R&D	Research and Development
RDT&E	Research, Development, Test and Evaluation
RFP	Request For Proposal
ROC	Required Operational Capability
SCP	System Concept Paper
SCRE	Stratified Charged Rotary Engine
SDR	System Design Review
SECDEF	Secretary of Defense
SECNAV	Secretary of the Navy
SESSO	Surface Effects Ship Support Office
SLEP	Service Life Extension Program
SOW	Statement of Work
SSR	Software Specification Review
STOM	Ship To Objective Maneuver
TEMP	Test and Evaluation Master Plan
TDP	Technical Data Package
TOC	Total Ownership Cost
TRR	Test Readiness Review

UDLP	United Defense Limited Partnership
USD (A)	Under Secretary of Defense (Acquisition)
USD (A&T)	Under Secretary of Defense (Acquisition and Technology)
VECP	Value Engineering Change Proposal

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